SIST

SLOVENSKI STANDARD
SIST EN 50341-2-9:2016

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Nadzemni električni vodi za izmenične napetosti nad 1 kV - 2-9. del: Nacionalna normativna določila (NNA) za Združeno kraljestvo (na podlagi EN 50341-1:2012)

Overhead electrical lines exceeding AC 1 kV - Part 2-9: National Normative Aspects (NNA) for GREAT BRITAIN AND NORTHERN IRELAND (based on EN 50341-1:2012)

Ta slovenski standard je istoveten z: EN 50341-2-9:2015

ICS:

29.240.20	Daljnovodi	Power transmission and distribution lines

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

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English Version

Overhead electrical lines exceeding AC 1 kV - Part 2-9: National Normative Aspects (NNA) for Great Britain and Northern Ireland (based on EN 50341-1:2012)

This European Standard was approved by CENELEC on 2015-06-02.

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.

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

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Ref. No. EN 50341-2-9:2015 E

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Foreword

1. The British National Committee is identified by the following address:

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Attention: Secretary of PEL/11 Overhead lines – Standards Development

2. The British National Committee has prepared this NNA (part 2-9 of EN 50341) listing the GB National Normative Aspects under its sole responsibility and duly passed this document through the CENELEC and CLC/TC 11 procedures.

   NOTE: The British National 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 Part 2-9 is normative in GB and informative for other countries.

4. This document shall be read in conjunction with Part 1 (EN 50341-1). All clause numbers used in this NNA correspond to those in Part 1. Specific sub-clauses that are prefixed "GB" are to 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 British NC who will, in co-operation with CLC/TC 11, clarify the requirements.

   Where no reference is made in this NNA to a specific sub-clause, then Part 1 shall apply.

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 GB and Northern Ireland.

   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 GB and Northern Ireland standards/ regulations relating to overhead electrical lines exceeding A.C. 1 kV are listed in subclause 2.1.

7. The British NC declares in accordance with clause 4.1 of Part 1 that this NNA follows both design "Approach 1" and design "Approach 3". The specific design Approach to be used shall be specified in the Project Specification.

1 SCOPE

1.1 General

(ncpt) **GB.1 General**

This NNA is only applicable to all new overhead lines above A.C. 1kV.

This Euronorm is only applicable to new overhead lines and shall not be applied to maintenance, reconductoring, tee-offs, extensions or diversions to existing overhead lines unless specifically required by the Project Specification.

For details of the application of this standard for overhead lines constructed with covered conductor refer to the Project Specification.

For details of the application of this standard to telecommunication systems involving optical fibres either incorporated in or wrapped around earthwires or conductors or suspended from overhead line supports, reference should be made to the Project Specification.

2 NORMATIVE REFERENCES, DEFINITIONS AND SYMBOLS

2.1 Normative references

(A-dev) **GB.1 National statutes**

Reference	***Name and Date of GB and NI Statute***
	Electricity Act 1989, Chapter 29,
	Health and Safety at Work Act 1974 and subsequent amendments
SI 635	*The Electricity at Work Regulations 1989 (Northern Ireland) 1991*
SI 1355	*The Electricity (Overhead Lines) Regulations 1970*
SI 2035	*The Overhead Lines (Exemption) Regulations 1990*
SI 2665	*The Electricity Safety, Quality and Continuity Regulations 2002*
SI 381	*The Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012*
SI 3074	*The Overhead Lines (Exemption) Regulations 1992*
SI 320	*The Construction (Design & Management) Regulations 2007*
SI 231(NI)	*Electricity (Northern Ireland) Order 1992*
SR 142	*The Construction (Design & Management) (Amendment) Regulations (Northern Ireland) 2001*
SR 209	*The Construction (Design & Management) Regulations (Northern Ireland) 1995*
SR 536	*Electricity Supply Industry Regulations (Northern Ireland) 1991*
SR 21	*Electricity Supply (Amendment) Regulations (Northern Ireland) 1993*
SI 1039 (NI9)	*Health and Safety at Work (Northern Ireland) Order 1978*
SI 2448 (S.165)	*The Electricity Act 1989 (Scotland)*

(ncpt) **GB.2 National normative standards**

BSEN 1991-1-4:2005	*Actions on Structures - Part 1-4: General Actions – Wind actions*
BSEN 1995-1-1:2008	*Design of Timber Structures – Part 1-1 General – Common rules and rules for buildings*
BS 7354:1990	*Design of high-voltage open-terminal stations*
BSEN 10025	*Hot rolled products of structural steels*
BSEN 14229:2010	*Structural timber – wood poles for overhead lines*
BSEN 50182:2001	*Conductors for overhead lines – round wire concentric lay stranded conductors*

Electricity Association Technical Report (EATR) 111 - High Voltage Single Circuit Overhead Lines on Wood Poles (1991)

2.3 Symbols

(ncpt) **GB.1 Additional symbols**

A_{SITE}	altitude of the site above mean sea level
a	altitude in metres above sea level of the conductor
c_{alt}	altitude factor
c_{dir}	wind direction factor
D_c	diameter of the conductor, mm
f_{yb}	yield strength for bolt
K_i	ice thickness coefficient
K_c	shape factor
L	length of conductor span, m
N_c	number of phases and earthwires
q_x	wind pressure on conductor, N/m²
q_c	wind pressure on structural element, N/m²
r_B	basic radial thickness of ice, mm
r_o	radial ice thickness in mm in the absence of wind, mm
r_r	reference ice thickness, mm
r_w	radial ice thickness in mm in the presence of wind
$v_{b,0}$	fundamental basic wind velocity, m/sec
$v_{b,map}$	10-minute wind velocity at sea level taken from a GB map, m/sec
z	height above ground, m
γ_v	partial safety factor on wind speed and ice thickness (partial factors on actions)
γ_m	partial factor on strength of structural materials
γ_{dl}	partial factors on permanent actions

3 BASIS OF DESIGN

3.2 Requirements of overhead lines

3.2.2 Reliability requirements

(ncpt) **GB.1 Reliability levels**

The partial coefficients to be used for the reliability levels are shown in Table 4.13.1/GB.1. The required reliability level shall be stated in the Project Specification. For temporary loading conditions reduced reliability levels may be specified.

3.2.5 Strength coordination

(ncpt) **GB.1 Strength coordination**

The required degree of strength coordination shall be stated in the Project Specification.

3.2.6 Additional considerations

(ncpt) **GB.1 Additional considerations**

Higher partial factors than those shown within this NNA may be specified in the Project Specification. Any additional considerations shall also be stated in the Project Specification.

3.3 Limit states

3.3.3 Serviceability limit states

(ncpt) **GB.1 Specific requirement**

These shall be defined in the Project Specification.

4 ACTIONS ON LINES

4.1 Introduction

(ncpt) **GB.1 Peak factor equation**

The formulation in the UK National Annex to BS EN 1991-1-4 modifies the parameter to define peak pressures by adopting a "peak factor" of 3,0 with a quadratic equation, rather than 3,5 with a linear equation, as used in BS EN 1991-1-4. The decision to change the formulation was due to the use of the ten minute wind speed in BS EN 1991-1-4 and the greater accuracy in the quadratic expression. As a consequence of this, equations included in clauses 4.3.4, 4.4.1.2, 4.4.3.2, 4.4.3.3 need to be amended as follows for use in the UK:

Replace the expression: $[1 + 7I_v(z)]$
with: $[1 + 3{,}0I_v(z)]^2$

(ncpt) **GB.2 Design approach definition**

Approach 1 (as detailed in BS EN 50341-1:2012 Clause 4.1) shall be adopted for all new overhead lines supported on steel poles or lattice steel towers.

For overhead lines supported on timber poles, the project specification shall specify either design Approach 3 or 1.

4.3 Wind loads

4.3.1 Field of application and basic wind velocity

(snc) **GB.1 Calculation of basic wind velocity**

Partial factor (γ_v) taken from Table 4.13.1/GB.1 for the specified Reliability Level shall be applied to the basic wind velocity ($v_{b,0}$) instead of applied to wind loading as given in Table 4.7 of BSEN 50341-1. The partial factor Ψ_w shall not be used.

The fundamental basic wind velocity, $v_{b,0}$ should be determined by the equation:

$$v_{b,0} = \gamma_v \; v_{b,map} \; c_{alt}$$

Where, $v_{b,map}$ is the fundamental velocity indicated in Figure NA.1 and c_{alt} is the altitude factor calculated as follows:

$$c_{alt} = 1 + 0{,}001 \; A_{SITE}$$

where: A_{SITE} is the altitude of the site in metres above mean sea level

The above may be used for all site altitudes, but may be considered over-conservative at high altitudes, in which case c_{alt} may be calculated for each element greater than 10m above ground using the modified formula:

$$c_{alt} = 1 + 0{,}001 \; A_{SITE} \; (10/h)^{0.2}$$

Where h is the height above ground level in metres at the point of application of the wind load. For calculation of wind loading on conductors and insulators, h may be taken as the mean height of the conductor attachment points. For calculation of wind on towers, structures may be divided in a number of panels of up to 10m in height, and h taken as the mean height of each panel.

4.3.2 Mean wind velocity

(ncpt) **GB.1 Wind Direction**

Wind direction factor C_{dir} may conservatively be taken as 1,0 or from Table 4.3.2/GB.1 below.

Table 4.3.2/GB.1 Wind direction factors

Direction	0	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
C_{dir}	0,78	0,73	0.73	0,74	0,73	0,80	0,85	0,93	1,00	0,99	0,91	0,82

NOTE 1 Interpolation may be used
NOTE 2 The directions are defined by angles from due North in a clockwise direction, for wind *from* the specified direction (eg. 0° means wind *from* due North)

NOTE. Unless stated otherwise in the project specification, wind from every direction from 0 to 345° shall be considered for the design in 15° increments.

(ncpt) **GB.2 Seasonal factor, c_{season}**

Where a temporary loading condition will remain in place for less than 1 year, the appropriate c_{season} factor may be applied in the calculation of mean wind speed as indicated in Table NA.2.7 in National Annex to BSEN 1991-1-4:2005. Note that the appropriate factor will not be applied in conjunction with wind speeds of less return period than 50 years.

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

The orography factor, c_o shall be taken as 1,0 where the average ground slope is not greater than 5% (1:20), measured over a distance of 10 times the height of the supports from the line. For greater slopes, reference shall be made to Figure NA.2 in National Annex to BSEN 1991-1-4:2005+A1, “Definition of significant orography [definition of symbols given in A.3(3)]”. For sites lying within the shaded area of that figure, the method given in BSEN 1991-1-4 A.3 for calculation of c_o may be used. As an alternative, or if the topography is complex, calculation by wind engineering specialists using digital terrain models may be less labour intensive and give more accurate results.

(ncpt) **GB.4 Loading on conductors**

For calculation of the load on supports due to wind loading on conductors (excluding those indirect effects due to conductor tension) the magnitude of the height above ground (h) adopted for the calculation of $V_h(h)$ shall generally be taken as the average height to the attachment of the support considered except in the case of spans crossing deep valleys, river estuaries or hills where the attachment heights would not be representative of the actual heights to the conductors away from the supports. In these cases, the value of h adopted shall be adjusted to approximately represent the mean height from the ground or water level to the attachment points on the supports. Alternatively, advice from a wind engineering specialist may be sought.

4.3.3 Mean wind pressure

(snc) **GB.1 Air density**

Air density in Great Britain shall be taken as 1,226 kg/m³. Table 4.2 in BSEN 50341-1:2012 shall not be used.

4.4 Wind forces on overhead line components

(snc) **GB.1 Design Approach 3**

Table 4.4.1/GB.1 details the design wind pressures and drag factors to be adopted for design Approach 3.

The span factor G_c shall be assumed to be 1,0 for wind span lengths up to 200m and (0,75L + 30)/L metres for wind span lengths greater than 200m. Normal and High altitudes are defined as follows:

Normal altitude: All of GB and Northern Ireland, except Scotland, site altitudes not exceeding 300m. For Scotland, site altitudes not exceeding 200m. More onerous requirements may be detailed in the Project Specification.

High altitude: All of GB and Northern Ireland, except Scotland, site altitudes greater than 300m but not exceeding 500m. For Scotland, site altitudes greater than 200m but not exceeding 500m. For lines at altitudes greater than 500m, a special consideration should be made as detailed in the Project Specification.

Table 4.4.1/GB.1 Wind pressures and aerodynamic drag factors

Load Condition	Wind Pressure (N/m^2)		Aerodynamic drag factors	
	q_x	q_c	C_x	C_c
High Wind (no ice)	1740	1740	0,8	1,0
Combined Wind and Ice (Normal altitude)	380	380	1,0	1,0
Combined Wind and Ice (High altitude)	570	570	1,0	1,0
Wind only (no ice)	0	760	-	1,0
Security (broken wire)	380	380	1,0	1,0
NOTE: for the leeward (shielded) pole, a shielding factor of 0,5 shall be assumed				

4.4.1 Wind forces on conductors

4.4.1.1 General

(ncpt) **GB.1 Calculation of G_c**

The wind loading adopted for calculation of the mechanical tension in a section of line shall be based on a value of conductor structural factor, G_c derived using a length value, L_m equal to the section length or 800m whichever is the less, together with a height, h based on the mean height of the conductor attachment point over length L_m. The mean height of the conductors shall be adjusted for deep valleys, river estuaries and hills as described in 4.3.2/ GB.4 above.

4.4.1.3 Drag Factor

(ncpt) **GB.1 Calculation of Reynold's number**

In the calculation of drag factor for conductors (c_c) Method 3 shall be used for stranded conductors, using an effective Reynold's number (Re). The values given in 4.4.1.3 shall be used for normal stranded conductors without ice. Other values are given in Table 4.4.1/GB.2 below.

Where: $Re = (1{,}42\, V_h \cos Ø_c\, d) / v$

and where: v is the kinematic viscosity of air, taken as $1{,}46 \times 10^{-5}$ m²/s

$Ø_c$ is the angle between the wind direction and plane normal to the conductor

Table 4.4.1/GB.2 Typical Drag Factors for elements

Member type	Effective Reynold's number (Re)	Drag Factor (C_c)	
		Ice free	Iced
Circular sections, smooth wire and smooth bodied conductors	$\leq 2 \times 10^5$	1,2	1,2
	4×10^5	0,6	1,0
	$> 10 \times 10^5$	0,7	1,0
Normal stranded conductors with more than seven strands	$\leq 6 \times 10^4$ $\geq 10^5$	1,2 0,9	- -
	$\leq 1 \times 10^5$ $\geq 2 \times 10^5$	- -	1,25 1,0
Thick stranded cable, e.g small wire ropes, round wire ropes, spiral steel strand with seven wires only	$\leq 4 \times 10^4$ $> 4 \times 10^4$	1,3 1,1	- -
	$\leq 1 \times 10^5$ $\geq 2 \times 10^5$	- -	1,25 1,0
Flat sided sections and plates	All values	2,0	2,0
NOTE For intermediate values of R_e, Cc should be obtained by linear interpolation			

4.4.3 Wind forces on lattice towers

4.4.3.1 General

(ncpt) **GB.1 General**

Method 1 shall be adopted when calculating wind loading on lattice towers.