



BSI Standards Publication

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)

National foreword

This British Standard is the UK implementation of EN 50341-2-9:2017+A1:2018. It supersedes BS EN 50341-2-9:2017, which is withdrawn.

This Standard, together with the following list of National Normative Aspect Standards, supersedes BS EN 50423-3:2005 and BS EN 50341-3:2001.

Country Code	Origin	Ref
AT	Austrian National Committee	BS EN 50341-2-1
BE	Belgian National Committee	BS EN 50341-2-2
CH	Swiss National Committee	BS EN 50341-2-3
DE	German National Committee	BS EN 50341-2-4:2016
DK	Danish National Committee	BS EN 50341-2-5:2017
ES	Spanish National Committee	BS EN 50341-2-6:2017
FI	Finnish National Committee	BS EN 50341-2-7:2015
FR	French National Committee	BS EN 50341-2-8
GB	British National Committee	BS EN 50341-2-9:2017+A1:2018
GR	Greek National Committee	BS EN 50341-2-10
IE	Irish National Committee	BS EN 50341-2-11
IS	Iceland National Committee	BS EN 50341-2-12
IT	Italian National Committee	BS EN 50341-2-13:2017
LU	Luxemburg National Committee	No NNA available
NL	Nederland's National Committee	BS EN 50341-2-15
NO	Norwegian National Committee	BS EN 50341-2-16:2016
PT	Portuguese National Committee	BS EN 50341-2-17
SE	Swedish National Committee	BS EN 50341-2-18:2016
CZ	Czech National Committee	BS EN 50341-2-19:2015
EE	Estonian National Committee	BS EN 50341-2-20:2015
PL	Polish National Committee	BS EN 50341-2-22:2016
SK	Slovak National Committee	BS EN 50341-2-23:2016

BS EN 50423-3:2005 and BS EN 50341-3:2001 will be withdrawn upon publication of the rest of the series.

The UK participation in its preparation was entrusted to Technical Committee PEL/11, Overhead Lines.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2018

Published by BSI Standards Limited 2018

ISBN 978 0 539 01973 5

ICS 29.240.20

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 October 2017.

Amendments/corrigenda issued since publication

Date	Text affected
31 August 2018	Implementation of CENELEC amendment A1:2018: Table J.3/ GB.1 replaced

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 2017-04-26.

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, Serbia, 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

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

CONTENTS

1	Scope	6
1.1	General	6
2	Normative References, definitions and symbols.....	6
2.1	Normative references	6
2.3	Symbols.....	7
3	Basis of design.....	7
3.2	Requirements of overhead lines	7
3.2.2	Reliability requirements	7
3.2.5	Strength coordination	7
3.2.6	Additional considerations.....	7
3.3	Limit states	7
3.3.3	Serviceability limit states	7
4	Actions on lines	8
4.1	Introduction.....	8
4.3	Wind loads.....	8
4.3.1	Field of application and basic wind velocity	8
4.3.2	Mean wind velocity	9
4.3.3	Mean wind pressure	9
4.4	Wind forces on overhead line components	9
4.4.1	Wind forces on conductors.....	10
4.4.3	Wind forces on lattice towers	11
4.5	Ice loads	11
4.6	Combined Wind and Ice loads	12
4.7	Temperature effects	13
4.8	Security loads	13
4.9	Safety loads.....	14
4.9.1	Construction and maintenance loads	14
4.9.2	Loads related to the weight of linesmen	14
4.10	Forces due to short-circuit currents.....	14
4.11	Other special forces	14
4.12	Load cases	15
4.12.2	Standard load cases.....	15
4.13	Partial factors for actions	16
5	Electrical requirements	19
5.2	Currents.....	19

5.2.1	Normal current.....	19
5.2.2	Short circuit current	19
5.5	Minimum air clearance distances to avoid flashover	20
5.5.3	Empirical method based on European experience.....	20
5.6	Load cases for calculation of clearances.....	20
5.6.1	Load cases for calculation of clearances	20
5.6.3	Wind load for determination of electric clearances	20
5.6.4	Ice load for determination of electric clearances	20
5.6.5	Combined wind and ice loads.....	20
5.8	Internal clearances within the span and at the top of support	20
5.9	External clearances	21
5.9.1	General.....	21
5.9.4	External clearances to crossing traffic routes	21
5.9.6	External clearances to other power lines or overhead telecommunication lines.....	22
5.9.7	External clearances to recreational areas (playgrounds, sports areas, etc.)	22
5.10	Corona effect.....	22
5.10.2	Audible noise	22
5.10.3	Corona loss	22
5.11	Electrical and magnetic field	22
5.11.1	Electrical and magnetic fields under a line	22
6	Earthing Systems.....	22
6.2	Ratings with regard to corrosion and mechanical strength.....	22
6.2.1	Earth electrodes	22
6.4	Dimensioning with regard to human safety.....	22
7	Supports	23
7.3	Lattice steel towers	23
7.3.6	Ultimate limit states.....	23
7.4	Steel poles.....	23
7.4.5	Structural analysis	23
7.4.6	Ultimate limit states	23
7.5	Wood Poles	24
7.5.1	General.....	24
7.5.5	Ultimate limit states	24
7.7	Guyed structures	25
8.	Foundations.....	25
8.2	Basis of geotechnical design	25
8.2.2	Geotechnical design	25
8.2.3	Design by prescriptive measures	25
8.2.4	Load tests and tests on experimental models	25
8.4	Supervision of construction, monitoring and maintenance	25
9.	Conductor and earth wires	26

10. Insulators	26
10.10 Characteristics and dimensions of insulators	26
11 Line equipment – overhead line fittings	27
11.9 Characteristics and dimensions of insulator fittings.....	27
12 Quality assurance, checks and taking-over	27
Annex J Angles in lattice steel towers.....	27
J.4 Buckling resistance of angles in compression (see 7.3.6.4)	27
J.4.2 Effective non-dimensional slenderness for flexural buckling	27
J.4.3 Slenderness of members	27
J.4.3.3 Primary bracing patterns.....	27
J.5 Design resistance of bolted connections (see 7.3.8)	28
J.5.1 General	28
Figure NA.1 10-Minute mean wind speeds for GB, $v_{b, map}$ in metres per second.....	29
Figure NA.2 Ice thickness for GB, r_o and (r_w) in millimetres	30
Figure NA.3 Weather Zones for site heights of 0 to 100m	31
Figure NA.4 Weather Zones for site heights of 100 to 200m	32
Figure NA.5 Weather Zones for site heights of 200 to 300m	33
Figure NA.6 Weather Zones for site heights of 300 to 400m	34
Figure NA.7 Weather Zones for site heights of 400 to 500m	35

European foreword

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

British Standards Institution

389 Chiswick High Road

London W4 4AL

Tel: +44 20 8996 9000

Fax: +44 20 8996 7799

Email: info@bsi.org.uk

2. The British National Committee (NC) has prepared this Part 2-9/A1 (EN 50341-2-9:2017/A1) listing the GB National Normative Aspects Amendment 1 (NNA/A1) under its sole responsibility and duly passed this document through the CENELEC and CLC/TC 11 procedures.

NOTE: The British NC also takes sole responsibility for the technically correct co-ordination of this EN 50341-2-9:2017/A1 with Part 2-9 (EN 50341-2-9:2017). 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/A1 is normative in GB and informative for other countries.
4. This NNA/A1 shall be read in conjunction with Part 2-9 and Part 1. The highlighted text (in yellow) shows the changes. All clause numbers used in this NNA/A1 correspond to those in Part 2-9 and Part 1. Specific sub-clauses that are prefixed 'GB' are to be read as amendments to the relevant text in Part 1 and Part 2-9. Any necessary clarification regarding the application of this NNA/A1 in conjunction with Part 2-9 and 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/A1 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/A1, shall be taken into account in GB and Northern Ireland.

However any boxed value whether in Part 1 or in this NNA/A1, shall not be modified 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.

NOTE: all national standards referred to in this NNA/A1 will be replaced by the relevant European Standards as soon as they become available and are declared by the British NC to be applicable and thus reported to the secretary of CLC/TC 11

7. The British NC declares in accordance with clause 4.1 of Part 1 that this NNA/A1 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

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

(ncpt) GB.2 National normative standards

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

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_c	wind pressure on conductor, N/m ²
q_x	wind pressure on structural element, N/m ²
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
$V_{b,\text{map}}$	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

GB.1 Basic Requirements

3.2 Requirements of overhead lines

Design Approach 1

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

Design Approach 1

(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: $[1 + 7/v(z)]$
with: $[1 + 3,0/v(z)]^2$

(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.

Approach 2 (as detailed in BS EN 50341-1:2012 Clause 4.1) may be used subject to the availability of suitable statistical data, and the agreement of the client. Before doing so, the proposed methodology for design, and the quality of the statistical data, shall be subject to a rigorous review by an independent expert to confirm that Reliability Levels equivalent to those provided by Design Approach 1 would be achieved with the proposed Design Approach 2.

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

NOTE Approaches 1 and 3 are based on different design philosophies and care should be taken not to combine elements of the two when undertaking calculations. The parts of this standard which apply only to Approach 3 are shown shaded grey in this document.

4.3 Wind loads

4.3.1 Field of application and basic wind velocity

Design Approach 1

(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