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Nadzemni električni vodi za izmenične napetosti nad 1 kV in do vključno 45 kV – 1. del: Splošne zahteve – Skupna določila

Overhead electrical lines exceeding AC 1 kV up to and including AC 45 kV – Part 1: General requirements – Common specifications

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Overhead electrical lines exceeding AC 1 kV up to and including AC 45 kV Part 1: General requirements – Common specifications

Lignes électriques aériennes dépassant 1 kV AC jusqu'à 45 kV AC
Partie 1: Exigences générales – Spécifications communes

Freileitungen über AC 1 kV bis einschließlich AC 45 kV
Teil 1: Allgemeine Anforderungen – Gemeinsame Festlegungen

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CENELEC
European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 11, Overhead electrical lines exceeding 1 kV a.c. (1,5 kV d.c.).

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50423-1 on 2004-10-01.

This European Standard is to be read with EN 50341-1:2001.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2005-10-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2007-10-01

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Introduction

This standard is based on EN 50341-1 "Overhead electrical lines exceeding AC 45 kV – Part 1: General requirements – Common Specifications".

As an aid to the user the clause numbers of this standard refer to, amend, substitute for or add to the text of the same clause number in EN 50341-1. Consequently, contrary to usual practice, the clauses of this standard are not numbered sequentially.

In order to avoid confusion regarding references to NNAs, the NNAs of EN 50341 (ie. EN 50341-3) are referred to as "associated NNAs" to EN 50341. All other reference to NNAs in this standard refer to those included in EN 50423-3, which may be either entirely new NNAs or amended and updated NNAs of EN 50341-3.

1 Scope

This standard applies to bare and covered conductor overhead lines and overhead insulated cable systems with nominal voltage exceeding AC 1 kV up to and including AC 45 kV and with rated frequencies below 100 Hz.

In general the requirements in EN 50341-1 apply. This standard specifies additional requirements and simplifications that apply only for this voltage range.

In connection with EN 50341-1, this standard specifies the general requirements that shall be met for the design and construction of new overhead lines to ensure that the line is suitable for its purpose with regard to safety of persons, maintenance, operation and environmental considerations.

This standard does not apply to:

– overhead electric lines inside closed electrical areas as defined in HD 637 S1;

– catenary systems of electrified railways unless explicitly required by another standard.

2 Definitions, list of symbols and references

As EN 50341-1, except the following are added:

2.1 Definitions

2.1.14 conductor (of an overhead line)

2.1.14.1
covered conductor
conductor surrounded by a covering made of insulating material to protect against accidental contact between other covered conductors and with earthed parts. Due to being unscreened, covered conductors are not sufficiently insulated to be touch-proof

2.1.14.2
overhead insulated cable system
system in which each conductor is surrounded by a covering made of insulating material, which fully protects against all leakage currents phase to phase or to earthed parts. In the majority of cases, each phase conductor will have a core screen. Examples of such overhead insulated cable system include: aerial bundled conductors (ABC); self-supporting and lashed underground cable; and "Universal" cable systems

2.1.107
glu-lam wooden poles
an abbreviation for glued laminated wooden poles. In respect of this standard, the term refers to wooden poles manufactured from such glued laminations in contrast to naturally grown timber poles

2.2 List of symbols

The following symbols are additional to those included in EN 50341-1.

Symbol	Signification	References
a	spacing of the two poles of a structure at half structure height	4.2.2.4.4
c	minimum clearance between the conductors at mid-span	5.4.3.1
d	diameter of the insulated cable/ line	Table 5.4.3
d_m	the average of the mean diameters from two separate poles	4.2.2.4.4
f	sag of the conductor at a temperature of +40 °C	5.4.3.1
k_a	coefficient according to Table 5.4.3.1	5.4.3.1
l_k	length in m of any insulator set swinging orthogonal to the line direction	5.4.3.1

2.3 References

The following references are additional to the reference list in EN 50341-1.

Reference	Title
EN 12843	Precast concrete masts and posts
EN 14229 [1)]	Wood poles for overhead lines. Requirements
EN 50341-1	Overhead electrical lines exceeding AC 45 kV Part 1: General requirements – Common specifications
EN 50341-3	Overhead electrical lines exceeding AC 45 kV Part 3: Set of National Normative Aspects
EN 50397-1 [1)]	Covered conductors for overhead lines and the related accessories for rated voltages above 1 kV a.c. and not exceeding 36 kV a.c. – Part 1: Covered conductors
IEC 61952	Insulators for overhead lines with a nominal voltage above 1 000 V. Composite line post insulators for a.c. systems.

3 Basis of design

3.1 General

The provisions specified in EN 50341-1 apply. Exceptions to these, if applicable, shall be specified in the NNAs. This clause of the standard provides the basis and the general principles for the design of lines with nominal rated voltages exceeding AC 1 kV, up to and including AC 45 kV (in respect of bare and covered conductor overhead lines and overhead insulated cable systems).

The fifth paragraph of Subclause 3.1 in EN 50341-1 shall be replaced by the following:

In principle, there are two approaches used to determine numerical values for actions and for partial factors. The first is on the basis of the statistical evaluation of meteorological and experimental data and field observations (later called the General Approach) which is based on a probabilistic reliability theory as described in IEC 60826. A second approach (later called the Empirical Approach) is on the basis of using actions obtained by a long experience of construction of overhead lines. Such specific national designs may be specified in the NNAs.

1) At draft stage.

4 Actions on lines

4.1 Introduction

With respect to actions on structures, overhead electric lines with nominal voltage exceeding AC 1 kV up to and including AC 45 kV shall be generally designed according to EN 50341-1 and the associated NNAs. The following clauses specify additional requirements and simplifications that apply only for these voltage ranges.

4.2 Actions, General approach

4.2.2.1.6 Wind Speed V_h at arbitrary height h above ground

For elements with a maximum height of 20 m a constant value of the dynamic wind pressure calculated at 10 m height specified in EN 50341-1 is allowed. Specific regulations shall be specified in the NNAs.

4.2.2.3 Wind force on any element of the line

The definition of G_x in EN 50341-1 is valid for all poles. In the following subclauses, simplified figures for the structural resonance factors of conductors and poles are given.

4.2.2.4.1 Wind forces on conductors

Table 4.2.5 – Span factors G_c

Terrain category	Span factor G_c as function of wind span L			
	Formulae	100 m	200 m	300 m
I	1,30 – 0,073 ln (L)	0,96	0,91	0,88
II	1,30 – 0,082 ln (L)	0,92	0,87	0,83
III	1,30 – 0,098 ln (L)	0,85	0,78	0,74
IV	1,30 – 0,110 ln (L)	0,79	0,72	0,67

NOTE 1 The formulae for G_c are a simplification of the general expression for G_x given in 4.2.2.3 of EN 50341-1. The span factor has been estimated on the basis of a wind front covering the span on both sides of the support.

NOTE 2 For the calculation of the conductor tension a reduction in the effect of the wind pressure due to the section length may be taken into account if the terrain conditions and the conductor height above ground remain the same. In such a case, a span factor based on the section length of the line may be applied.

NOTE 3 The formulae given above are not valid for wind spans below 100 m. The values of G_c below 100 m shall be calculated by linear interpolation between G_c = 1,0 for 0 m span, and the calculated value of G_c for 100 m span.

4.2.2.4.4 Wind forces on poles

The following are representative drag factors, C_{pol} based on a slenderness ratio, λ, of 50. For a greater degree of accuracy, particularly for rectangular profile poles, reference shall be made to ENV 1991:

– tubular steel, composite and reinforced concrete poles with circular profile		0,7
– wood poles (except glu-lam wooden poles) with circular cross-section and tubular steel and reinforced concrete poles with duo-decagonal profile		0,8
– tubular steel and reinforced concrete square and rectangular poles		1,5
– reinforced concrete poles with I or H profile (without any distinction for openings)		1,6
– steel poles with H profile :		1,8
– tubular steel, reinforced concrete and glu-lam wooden poles with hexagonal profile		1,4
– glu-lam wooden poles with square profile		1,8
– glu-lam wooden poles with rectangular profile		1,9
– tubular steel, reinforced concrete and glu-lam wooden poles with octagonal profile		1,3
– tubular steel, reinforced concrete and glu-lam wooden poles with decagonal profile and glu-lam wooden poles with duo-decagonal profile		1,2
– double and A-shaped wooden poles with circular cross-section (except glu-lam wooden poles):		
• in the plane of the pole, that part of the pole exposed to the wind		0,8
• in the plane of the pole, leeward pole of the structure	for $a < 2\ d_m$	0
	for $2\ d_m \leq a \leq 6\ d_m$	0,35
	for $a > 6\ d_m$	0,7
• perpendicular to the plane of the pole	for $a < 2\ d_m$	0,8

where

a is the spacing of the two poles at half structure height,

d_m is the average of the mean diameters from two separate poles.

The factors noted above are in addition to the requirements of Subclause 4.2.2.4.4 of EN 50341-1.

4.2.4 Combined wind and ice loads

Unless specified in the NNAs, all three scenarios of wind, wind and ice and ice only loads shall be considered.

4.2.5 Temperature effects

Subclause 4.2.5 of EN 50341-1 applies except for the following amendment:

Temperature effects in five different design situations may generally apply as described below. They will depend on the other climatic actions that may be present.

4.2.10 Load cases

Specific regulations shall be specified in the NNAs.

4.2.10.2 Standard load cases

For control of adequate reliability and functions under service conditions of the overhead line, load cases, including the standard load cases specified in Table 4.2.7 of EN 50341-1, may be defined in the NNAs.

4.2.11 Partial factors for actions

In Table 4.2.8 of EN 50341-1, Security Load partial factors shall be referenced "if specified in the NNAs".

4.3 Actions, Empirical approach

The requirements of Subclause 4.3 of EN 50341-1 are applicable for this voltage range.
Subclauses 4.2.2.4.1, 4.2.2.4.3, 4.2.2.4.4, 4.2.4, 4.2.5, 4.2.10 and 4.2.11 of Subclause 4.2 (Actions, General Approach) apply also for Subclause 4.3 unless otherwise specified in the NNAs.

5 Electrical requirements

5.0 General

With respect to electrical requirements, overhead lines with nominal voltage range exceeding AC 1 kV up to and including 45 kV shall be generally designed according to EN 50341-1 and the associated NNAs where not specified otherwise in this standard. The following clauses specify additional requirements and simplifications, which apply only for this voltage range.

5.1 Voltage classification

Table 5.1 gives nominal voltages and corresponding highest system voltages for the voltage range considered.

Table 5.1 – Nominal voltages and corresponding highest system voltages

Nominal voltage, U_n kV	Highest system voltage, U_s kV
3	3,6
6	7,2
10	12
15	17,5
20	24
22	25
30	36
35	38,5
45	52

5.3 Insulation co-ordination

5.3.5 Electrical clearance distances to avoid flashover

5.3.5.1 General

The provisions for the specification of basic electrical clearance distances in EN 50341-1, Subclause 5.3.5 and the associated NNAs apply. In the voltage range considered the basic electrical clearance to be used shall be the distance at which the electrical circuit considered withstands the lightning overvoltage. Differing from EN 50341-1, these minimum clearances shall, however, only be applied for the specification of the internal clearances of overhead line components.

5.3.5.3 Empirical approach

Table 5.5 – Clearances D_{el} and D_{pp} (for the verification of internal clearances)

Highest system voltage U_s kV	**D_{el}** in metres	**D_{pp}** in metres
3,6	0,08	0,1
7,2	0,09	0,1
12	0,12	0,15
17,5	0,16	0,2
24	0,22	0,25
25	0,23	0,26
36	0,35	0,4
38,5	0,38	0,45
52	0,60*	0,70
* A value of D_{el} = 0,48 m is given within EN 60071-1. The value of D_{el} quoted above is taken from EN 50341-1 Table 5.5.		

For the verification of external clearances to the ground and crossing of obstacles, D_{el} = 0,60 m shall be considered and D_{pp} = 0,7 m for crossings with other overhead lines, independent of the voltage level.

These basic electrical clearances are considered in Tables 5.4.3.1, 5.4.4, 5.4.5.2, 5.4.5.3.2, 5.4.5.4 and 5.4.5.5 in accordance with EN 50341-1 (from 5.3.5.3 Empirical approach).

5.4 Internal and external clearances

5.4.1 Introduction

The internal and external clearances, as given in Tables 5.4.3 and 5.4.4, are determined from a technical point of view and it is accepted that National Statutes may use different values (both higher and lower) and these shall be specified in the NNAs.

The clearances relate to lines which use bare and covered conductors and overhead insulated cables.

5.4.3 Clearances within the span and at the tower

Other methods than those given in the following clauses may be defined in NNAs to calculate the clearances in the span.