SLOVENSKI STANDARD
SIST EN 50341-2-6:2018

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Nadzemni električni vodi za izmenične napetosti nad 1 kV - 2-6. del: Nacionalna normativna določila (NNA) za Španijo (na podlagi EN 50341-1:2012)

Overhead electrical lines exceeding AC 1 kV - Part 2-6: National Normative Aspects (NNA) for SPAIN (based on EN 50341-1:2012)

Lignes électriques aériennes dépassant 1 kV en courant alternatif - Partie 2-6: Aspects normatifs nationaux (NNA)pour l'ESPAGNE (basé sur l'EN 50341-1:2012)

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29.240.20 Daljnovodi Power transmission and distribution lines

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EUROPEAN STANDARD

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English Version

Overhead electrical lines exceeding AC 1 kV - Part 2-6: National Normative Aspects (NNA) for SPAIN (based on EN 50341-1:2012)

Lignes électriques aériennes dépassant 1 kV en courant alternatif - Partie 2-13: Aspects normatifs nationaux (NNA)pour l'ESPAGNE (basé sur l'EN 50341-1:2012)

This European Standard was approved by CENELEC on 2017-02-01.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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Contents

Tables

European foreword

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

Asociación Española de Normalización (UNE)
c/Génova, 6
E 28004 Madrid
Spain

Tel. nº: + 34 915 294 900
Fax nº: + 34 91 310 45 96
Email: info@une.org

Name of the relevant technical body: AEN/CTN 207/SC 7-11 "Líneas eléctricas aéreas" (Overhead power lines)

2 The Spanish NC and its technical body AEN/CTN 207/SC 7-11 "Overhead power lines" has prepared this Part 2-6 of EN 50341, listing the Spanish National Normative Aspects (NNA) under its sole responsibility, and duly passed it through the CENELEC and CLC/TC 11 procedures.

NOTE: The Spanish NC also takes sole responsibility for the technically correct co-ordination of this EN 50341-2-6 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 2-6 is normative in Spain and informative in 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 of Part 1. Specific sub-clauses that are prefixed "ES", 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 Spanish 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 case of "boxed values" defined in Part 1, amended values (if any), which are defined in this NNA, shall be taken into account in Spain.

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 Spanish standards/regulations related to overhead electrical lines exceeding 1 kV A.C. are listed in sub-clause 2.1/ES.1 and ES.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 Spanish NC to be applicable and thus reported to the secretary of CLC/TC 11.

7 The Spanish NC declares, in accordance with sub-clause 4.1 of Part 1, that "Approach 3" shall be used in Spain to stablish numerical values of actions.

1 Scope

1.1 General

(ncpt) **ES.1 General**

This NNA is applicable to any new line between two points, A and B, its modifications and extensions.

1.2 Field of application

(A-dev) **ES.1 RD 223/2008, ITC-LAT 08, sub-clause 6.3.2**

The design and construction of overhead lines with covered conductors and voltages greater than 45 kV shall respect the same electrical clearances as of overhead lines with bare conductors of the same voltage.

2 Normative references, definitions and symbols

2.1 Normative references

(A-dev) **ES.1 National normative regulations**

Royal Decree (RD) 223/2008, of 15th February 2008, approving the Regulation on technical and safety conditions for high voltage electrical lines and its Supplementary Technical Instructions ITC-LAT 01 to 09

Royal Decree (RD) 337/2014, of 9th May 2014, approving the Regulation on technical and safety conditions for high voltage power installations and its Supplementary Technical Instructions ITC-RAT 01 to 23

Royal Decree (RD) 614/2001, of 8th June 2001, establishing the minimum health and safety requirements for the protection of workers against the electrical risk

Royal Decree (RD) 1955/2000, of 1st December 2000, regulating the activities of transmission, distribution, marketing and supply of electrical energy and the procedures for the authorization of installations

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

UNE 207016 "*HV and HVH type concrete poles for overhead electrical lines*"

UNE 207017 "*Lattice steel towers for distribution overhead electrical lines*"

UNE 207018 "*Plate metallic supports for overhead electrical lines*"

2.3 Symbols

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

a_{som}	minimum insulator set discharge gap, defined as shortest distance in straight line between live parts and earthed parts
A_T	wind exposed pole area projected in a wind direction perpendicular plane in m²
CS	minimum security factor defined for each element and load case
D	clearance between same or different circuits' phase conductors in metres
F	maximum sag in metres, for load cases defined in sub-clause 3.2.3
K	coefficient depending on the conductors' wind oscillation, it shall be selected from Table 5.8/ES.1
K'	coefficient depending on overhead lines nominal voltage. K' = 0,85 for special category lines and K' = 0,75 for other overhead lines
L	suspension set length in metres. For conductors attached to the pole with strain or post-insulator sets L = 0

V_V reference wind velocity in km/h

3 Basis of design

3.2 Requirements of overhead lines

3.2.2 Reliability requirements

(A-dev) **ES.1 RD 223/2008, clause 16**

For private overhead lines, a competent licensed technician, with the authorization of overhead line's owner, may adopt in emergency situations the recommended provisional steps, immediately advising to the competent Administration body, which shall set the period to restore the regulation conditions.

(ncpt) **ES.2 Reliability levels**

The minimum reliability level shall be 1. Actions for wind and ice are defined in section 4.

3.2.5 Strength coordination

(snc) **ES.1 Strength coordination**

Strength coordination is obtained by matching the security factors (CS) associated to each component and system of the overhead line.

3.6 Design values

3.6.2 Design value of an action

(A-dev) **ES.1 Design value of an action**

Actions shall not be affected by partial factors.

3.6.3 Design value of a material property

(A-dev) **ES.1 Partial factor for a material property**

The partial factor for a material property shall be:

$$X_d = X_K / CS$$

Where:

X_d *is the design value of the material property*
X_K *is the characteristic value of the material property*
CS *is the minimum security factor for each element and load case defined in sub-clause 4.13/ES.1*

3.7 Partial factor method and design formula

3.7.2 Basic design formula

(snc) **ES.1 Basic design formula**

When considering a limit state of rupture or excessive deformation of a component, element or connection, it shall be verified that:

$$R_d / E_d \geq CS$$

Where:

E_d	*is the total design value of the effect of actions, such as internal force or moment, or a representative vector of several internal forces or moments, as defined in sub-clause 3.7.2 of the main body*
R_d	is the corresponding structural design resistance*, as defined in sub-clause 3.7.2 of the main body*
CS	*is the minimum security factor for each element and load case defined in clause 4.13/ES.1*

4 Actions on lines

4.1 Introduction

(snc) **ES.1 Introduction**

Due to the lack, in general, of official statistical data, in Spain Approach 3 shall be used to stablish the numerical values of actions.

4.2 Permanent loads

(A-dev) **ES.1 RD 223/2008, ITC-LAT 07, sub-clause 3.1.1**

Vertical loads on account of own weight of each element shall be taken into account: conductors, insulators, fittings, ground wires – if they exist –, poles and foundations.

4.3 Wind loads

4.3.1 Field of application and basic wind velocity

(A-dev) **ES.1 RD 223/2008, ITC-LAT 07, sub-clause 3.1.2**

A minimum reference wind velocity of 120 km/h (33,3 m/s) shall be considered, except in lines with voltages of 220 kV and above, or lower voltages which are considered part of the transmission grid, in which a minimum reference wind velocity of 140 km/h (38,89 m/s) shall be considered.

This reference wind velocity (V_V) shall mean horizontal, acting perpendicular to the areas concerned.

4.3.5 Wind forces on any overhead line component

(A-dev) **ES.1 RD 223/2008, ITC-LAT 07, sub-clause 3.1.2.4**

In the case of a flat surface, the wind force, Q_{Wx}, shall be at least:

$$Q_{Wx} = 100 \cdot \left(\frac{V_V}{120}\right)^2 \cdot A_x \text{ daN}$$

Where:

V_V	*is the reference wind velocity in km/h.*
A_x	*is the area of the flat surface projected in a perpendicular plane to the wind direction, in m^2*

(A-dev) **ES.2 RD 223/2008, ITC-LAT 07, sub-clause 3.1.2.5**

In the case of a cylindrical surface, the wind force, Q_{Wx}, shall be, at least:

$$Q_{Wx} = 70 \cdot \left(\frac{V_V}{120}\right)^2 \cdot A_x \text{ daN}$$

Where:

V_V	*is the reference wind velocity in km/h.*
A_x	*is the area of the cylindrical surface projected in a perpendicular plane to the wind direction, in* m^2

(A-dev) **ES.3 RD 223/2008, ITC-LAT 07, sub-clause 3.1.2.1**

The wind force over conductors in a suspension pole, in the transversal direction of the line, for each conductor of the bundle shall be, at least, the following:

$$Q_{Wc\_V} = q_p \cdot d \cdot (L_1 + L_2) / 2 \text{ daN}$$

Where:

q_p *is the wind pressure, with the following value:*

$$= 60 \cdot \left(\frac{V_V}{120}\right)^2 \text{ daN/m}^2 \text{ for conductors } d \le 16 \text{ mm}$$

$$= 50 \cdot \left(\frac{V_V}{120}\right)^2 \text{ daN/m}^2 \text{ for conductors } d > 16 \text{ mm}$$

V_V is the reference wind velocity in km/h.

d	*is the conductor or sub-conductor diameter, in m. In the case of combined wind and ice load, the thickness of the ice shall be considered, for which a reference value of 7.500 N/m³ is recommended for the specific volumetric weight of ice.*
L_1, L_2	*are the lengths of the adjacent spans, in m.*

Any possible shade effects between conductors, even in the case of phase bundle conductors, shall be neglected.

For the wind forces over poles with angle, the influence of the direction change and the lengths of the adjacent spans shall be taken into account.

(A-dev) **ES.4 RD 223/2008, ITC-LAT 07, sub-clause 3.1.2.2**

The wind forces over the insulator sets shall be taken into account. The force value shall be, at least, the following:

$$Q_{Wins} = 70 \cdot \left(\frac{V_V}{120}\right)^2 \cdot A_{ins} \text{ daN}$$

Where:

V_V	*is the reference wind velocity in km/h.*
A_{ins}	*is the area of the insulator set projected horizontally in a vertical plane parallel to the axis of the insulator set.*

(A-dev) **ES.5 RD 223/2008, ITC-LAT 07, sub-clause 3.1.2.3**

The total force value of the wind over a lattice tower shall be, at least, the following:

$$Q_{Wt} = 170 \cdot \left(\frac{V_V}{120}\right)^2 \cdot A_T \text{ daN}$$

Where:

V_V	*is the reference wind velocity in km/h.*
A_T	*is the area of the tower projected in a perpendicular plane to the wind direction, in* m^2

4.4 Wind forces on overhead line components

(snc) **ES.1 Wind forces on overhead line components**

Due to the use in Spain of an alternative method to define the wind forces on overhead line components (Approach 3), the structural factors described in sub-clause 4.4 are not applicable.

4.5 Ice loads

4.5.2 Ice forces on conductors

(A-dev) **ES.1 RD 223/2008, ITC-LAT 07, sub-clause 3.1.3**

In Spain the ice load per length of the conductor, I (in daN per linear metre), shall be, at least:

- In zones with an altitude over the sea up to 500 m, I = 0
- In zones with an altitude over the sea between 500 and 1.000 m, I = $1{,}8\,\sqrt{d}$
- In zones with an altitude over the sea higher than 1.000 m, I = $3{,}6\,\sqrt{d}$

Where:

d *is the conductor diameter, in mm.*

4.7 Temperature effects

(A-dev) **ES.1 RD 223/2008, ITC-LAT 07, sub-clause 3.2.1**

In Spain, the following design situations shall be taken into account:

a) Minimum temperature, without other climatic action:

Not relevant.

b) Extreme wind velocity at next temperature:

- In zones with an altitude over the sea less than 500 m, T = -5 ºC
- In zones with an altitude over the sea between 500 and 1.000 m , T = -10 ºC
- In zones with an altitude over the sea more than 1.000 m, T = -15 ºC

c) Minimum temperature combined with a reduced wind velocity:

Not relevant.

d) Ice load at next temperature:

- In zones with an altitude over the sea between 500 and 1.000 m , T = -15 ºC
- In zones with an altitude over the sea more than 1.000 m, T = -20 ºC

e) Ice load combined with a reference wind velocity of, at least, 60 km/h, at next temperature:

- In zones with an altitude over the sea between 500 and 1.000 m , T = -15 ºC
- In zones with an altitude over the sea more than 1.000 m, T = -20 ºC

This situation shall only be taken into account in overhead lines with voltages of 220 kV and above, or lines with less voltage that belong to the transmission grid.

4.8 Security loads

4.8.1 General

(snc) **ES.1 General**

The security loads shall be taken into account in Spain for lines of nominal voltage up to 45 kV.

4.8.2 Torsional loads

(A-dev) **ES.1 RD 223/2008, ITC-LAT 07, sub-clause 3.1.5**

The breakage of (one or more) conductors of a single phase or ground wire shall be taken into account. This load shall be applied in a point producing the most unfavourable situation for any element of the pole, taking into account the torsion produced in the case this load is eccentric. In poles placed in a point in which the trace of the line suffers a direction change, the resultant load due to the tension angle of conductors and ground wires shall be additionally taken into account.

- Conductor breakage in poles with suspension sets.
  One sided load shall be taken into account, corresponding to the breakage of just one conductor or ground wire.
  This load could be reduced by special devices adopted to this purpose and due to the deviation of the suspension insulator set, but in this last case the minimum value to take into account shall be 50% of the broken conductor tension with one or two conductors per phase, the 75% of the broken conductor tension with three conductors per phase and 100% of the broken conductor tension in lines with four or more conductors per phase.
- Conductor breakage in poles with strain sets.
  One sided load shall be taken into account, corresponding to the breakage of just one conductor or ground wire without any reduction of its tension.
- Conductor breakage in anchor poles.
  The load corresponding to the breakage of a ground wire or conductor shall be taken into account in lines with one conductor per phase, with no reduction of its tension and, in lines with bundles the breakage of a ground wire or all the conductors of the bundle, but supposed those with a 50% tension reduction, without any other reduction.
- Conductor breakage in dead end poles.
  The load corresponding to the breakage of a ground wire or conductor shall be taken into account in lines with one conductor per phase and in lines with bundles the breakage of a ground wire or all the conductors of the bundle. In both cases without any reduction of its tension.
- Conductor breakage in special poles.
  It shall be considered depending on the purpose of each circuit installed in the pole, considering the load producing the most unfavourable situation for any element of the pole.

4.8.3 Longitudinal loads

(A-dev) **ES.1 RD 223/2008, ITC-LAT 07, sub-clause 3.1.4**

The unbalanced loads to be considered are applied in the conductor and ground wire attach point and shall take into account, therefore, the torsional loads that could be produced.

In poles placed in a point in which the trace of the line suffers a direction change, in addition, the resultant load due to the tension angle of conductors and ground wires shall be taken into account.

- Unbalance in poles with suspension sets.
  For lines with nominal voltage over 66 kV a longitudinal load equivalent to 15% the one sided tension of all conductors and ground wires shall be considered.
  For lines with nominal voltage up to and 66 kV a longitudinal load equivalent to 8% the one sided tension of all conductors and ground wires shall be considered. This load may be considered spread out in the axis of the pole at the height of the attach points of conductors and ground wires.
- Unbalance in poles with strain sets.
  For lines with nominal voltage over 66 kV a longitudinal load equivalent to 25% the one sided tension of all conductors and ground wires shall be considered.
  For lines with nominal voltage up to and 66 kV a longitudinal load equivalent to 15% the one sided tension of all conductors and ground wires shall be considered. This load may be considered spread out in the axis of the pole at the height of the attach points of conductors and ground wires.
- Unbalance in anchor poles.
  A longitudinal load equivalent to 50% the one sided tension of all conductors and ground wires shall be considered.