

BS EN 62305-2:2012



BSI Standards Publication

Protection against lightning

Part 2: Risk management

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

raising standards worldwide™



National foreword

This British Standard is the UK implementation of EN 62305-2:2012. It was derived from IEC 62305-2:2010. It supersedes BS EN 62305-2:2006, which will be withdrawn on 31 January 2014.

The CENELEC common modifications have been implemented at the appropriate places in the text. The start and finish of each common modification is indicated in the text by tags C C.

The UK participation in its preparation was entrusted to Technical Committee GEL/81, Protection against lightning.

The values assigned for certain parameters used as part of the risk evaluation process in this British Standard, are values proposed by IEC (specifically in Annexes B, C and the case studies in Annex E). It is recognized by IEC that these identified values may not be appropriate for application in all the countries that utilize this standard. Different values may be assigned by each national committee based upon each country's perception and importance they attribute to the relevant risk category.

The UK committee has reviewed the relevant parts of this standard and have provided appropriate UK interpretations which can be found in national annexes at the end of this standard. National Annex NF contains interpretations relating to Table 4 and reproduces the lightning flash density map for the British Isles together with the table and map showing the thunderstorm days throughout the world. Annexes B, C and E have been reproduced as National Annexes NB, NC and NE. The revised versions contain appropriate UK interpretations and in Annex NE two further examples, namely a heritage building and a bank computer centre, in order to provide a full representation of the four categories of risk and associated loss. These National Annexes should be used wherever and whenever the British Standard is adopted for designing lightning protection systems.

Due to the specific UK values outlined above, it is important to ensure that any software package used in conjunction with this standard is specifically designed to use the National Annexes in this document.

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 2013.

Published by BSI Standards Limited 2013

ISBN 978 0 580 61193 3

ICS 29.020; 91.120.40

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 30 April 2013.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

English version

**Protection against lightning -
Part 2: Risk management
(IEC 62305-2:2010, modified)**

Protection contre la foudre -
Partie 2: Evaluation des risques
(CEI 62305-2:2010, modifiée)

Blitzschutz -
Teil 2: Risiko-Management
(IEC 62305-2:2010, modifiziert)

This European Standard was approved by CENELEC on 2012-03-19. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, 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.

CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Contents

Foreword	6
Introduction	7
1 Scope	8
2 Normative references	8
3 Terms, definitions, symbols and abbreviations	8
3.1 Terms and definitions	8
3.2 Symbols and abbreviations	13
4 Explanation of terms	16
4.1 Damage and loss	16
4.2 Risk and risk components	18
4.3 Composition of risk components	20
5 Risk management	21
5.1 Basic procedure	21
5.2 Structure to be considered for risk assessment	22
5.3 Tolerable risk R_T	22
5.4 Specific procedure to evaluate the need of protection	22
5.5 Procedure to evaluate the cost effectiveness of protection	23
5.6 Protection measures	26
5.7 Selection of protection measures	26
6 Assessment of risk components	26
6.1 Basic equation	26
6.2 Assessment of risk components due to flashes to the structure (S1)	27
6.3 Assessment of the risk component due to flashes near the structure (S2)	27
6.4 Assessment of risk components due to flashes to a line connected to the structure (S3)	27
6.5 Assessment of risk component due to flashes near a line connected to the structure (S4)	28
6.6 Summary of risk components	29
6.7 Partitioning of a structure in zones Z_S	29
6.8 Partitioning of a line into sections S_L	30
6.9 Assessment of risk components in a structure with zones Z_S	30
6.10 Cost-benefit analysis for economic loss (L4)	31
Annex A (informative) Assessment of annual number N of dangerous events	32
A.1 General	32
A.2 Assessment of the average annual number of dangerous events N_D due to flashes to a structure and N_{DJ} to an adjacent structure	32
A.3 Assessment of the average annual number of dangerous events N_M due to flashes near a structure	37
A.4 Assessment of the average annual number of dangerous events N_L due to flashes to a line	38
A.5 Assessment of average annual number of dangerous events N_I due to flashes near a line	39
Annex B (informative) Assessment of probability P_X of damage	40
B.1 General	40
B.2 Probability P_A that a flash to a structure will cause injury to living beings by electric shock	40
B.3 Probability P_B that a flash to a structure will cause physical damage	41

B.4	Probability P_C that a flash to a structure will cause failure of internal systems	41
B.5	Probability P_M that a flash near a structure will cause failure of internal systems ..	43
B.6	Probability P_U that a flash to a line will cause injury to living beings by electric shock	44
B.7	Probability P_V that a flash to a line will cause physical damage	45
B.8	Probability P_W that a flash to a line will cause failure of internal systems	46
B.9	Probability P_Z that a lightning flash near an incoming line will cause failure of internal systems	46
Annex C (informative)	Assessment of amount of loss L_X	48
C.1	General	48
C.2	Mean relative amount of loss per dangerous event	48
C.3	Loss of human life (L1)	48
C.4	Unacceptable loss of service to the public (L2)	51
C.5	Loss of irreplaceable cultural heritage (L3)	52
C.6	Economic loss (L4)	53
Annex D (informative)	Evaluation of costs of loss	56
Annex E (informative)	Case study	57
E.1	General	57
E.2	Country house	57
E.3	Office building	62
E.4	Hospital	69
E.5	Apartment block	80
Bibliography	85

Figures

Figure 1	– Procedure for deciding the need of protection and for selecting protection measures	24
Figure 2	– Procedure for evaluating the cost-effectiveness of protection measures	25
Figure A.1	– Collection area A_D of an isolated structure	33
Figure A.2	– Complex shaped structure	34
Figure A.3	– Different methods to determine the collection area for the given structure	35
Figure A.4	– Structure to be considered for evaluation of collection area A_D	36
Figure A.5	– Collection areas (A_D , A_M , A_I , A_L)	39
Figure E.1	– Country house	57
Figure E.2	– Office building	62
Figure E.3	– Hospital	69
Figure E.4	– Apartment block	81

Tables

Table 1	– Sources of damage, types of damage and types of loss according to the point of strike	18
Table 2	– Risk components to be considered for each type of loss in a structure	20
Table 3	– Factors influencing the risk components	21
Table 4	– Typical values of tolerable risk R_T	22
Table 5	– Parameters relevant to the assessment of risk components	28
Table 6	– Risk components for different types of damage and source of damage	29
Table A.1	– Structure location factor C_D	37
Table A.2	– Line installation factor C_I	38

Table A.3 – Line type factor C_T	38
Table A.4 – Line environmental factor C_E	38
Table B.1 – Values of probability P_{TA} that a flash to a structure will cause shock to living beings due to dangerous touch and step voltages	40
Table B.2 – Values of probability P_B depending on the protection measures to reduce physical damage	41
Table B.3 – Value of the probability P_{SPD} as a function of LPL for which SPDs are designed	42
Table B.4 – Values of factors C_{LD} and C_{LI} depending on shielding, grounding and isolation conditions	42
Table B.5 – Value of factor K_{S3} depending on internal wiring	44
Table B.6 – Values of probability P_{TU} that a flash to an entering line will cause shock to living beings due to dangerous touch voltages	45
Table B.7 – Value of the probability P_{EB} as a function of LPL for which SPDs are designed	45
Table B.8 – Values of the probability P_{LD} depending on the resistance R_S of the cable screen and the impulse withstand voltage U_W of the equipment	45
Table B.9 – Values of the probability P_{LI} depending on the line type and the impulse withstand voltage U_W of the equipment	47
Table C.1 – Type of loss L1: Loss values for each zone	49
Table C.2 – Type of loss L1: Typical mean values of L_T , L_F and L_O	49
Table C.3 – Reduction factor r_t as a function of the type of surface of soil or floor	50
Table C.4 – Reduction factor r_p as a function of provisions taken to reduce the consequences of fire	50
Table C.5 – Reduction factor r_f as a function of risk of fire or explosion of structure	51
Table C.6 – Factor h_z increasing the relative amount of loss in presence of a special hazard	51
Table C.7 – Type of loss L2: Loss values for each zone	52
Table C.8 – Type of loss L2: Typical mean values of L_F and L_O	52
Table C.9 – Type of loss L3: Loss values for each zone	52
Table C.10 – Type of loss L3: Typical mean value of L_F	53
Table C.11 – Type of loss L4: Loss values for each zone	53
Table C.12 – Type of loss L4: Typical mean values of L_T , L_F and L_O	54
Table C.Z1 – Values to assess the total value c_t	54
Table C.Z2 – Portions to assess the total values c_a , c_b , c_c , c_s	55
Table E.1 – Country house: Environment and structure characteristics	58
Table E.2 – Country house: Power line	58
Table E.3 – Country house: Telecom line (TLC)	59
Table E.4 – Country house: Factors valid for zone Z_2 (inside the building)	60
Table E.5 – Country house: Collection areas of structure and lines	60
Table E.6 – Country house: Expected annual number of dangerous events	61
Table E.7 – Country house: Risk R_1 for the unprotected structure (values $\times 10^{-5}$)	61
Table E.8 – Country house: Risk components relevant to risk R_1 for protected structure	62
Table E.9 – Office building: Environment and structure characteristics	63
Table E.10 – Office building: Power line	63
Table E.11 – Office building: Telecom line	64
Table E.12 – Office building: Distribution of persons into zones	64
Table E.13 – Office building: Factors valid for zone Z_1 (entrance area outside)	65
Table E.14 – Office building: Factors valid for zone Z_2 (garden outside)	65

Table E.15 – Office building: Factors valid for zone Z_3 (archive)	66
Table E.16 – Office building: Factors valid for zone Z_4 (offices)	66
Table E.17 – Office building: Factors valid for zone Z_5 (computer centre)	67
Table E.18 – Office building: Collection areas of structure and lines	67
Table E.19 – Office building: Expected annual number of dangerous events	68
Table E.20 – Office building: Risk R_1 for the unprotected structure (values $\times 10^{-5}$)	68
Table E.21 – Office building: Risk R_1 for the protected structure (values $\times 10^{-5}$)	69
Table E.22 – Hospital: Environment and global structure characteristics	70
Table E.23 – Hospital: Power line	70
Table E.24 – Hospital: Telecom line	71
Table E.25 – Hospital: Distribution of persons and of economic values into zones	72
Table E.26 – Hospital: Factors valid for zone Z_1 (outside the building)	73
Table E.27 – Hospital: Factors valid for zone Z_2 (rooms block)	73
Table E.28 – Hospital: Factors valid for zone Z_3 (operating block)	74
Table E.29 – Hospital: Factors valid for zone Z_4 (intensive care unit)	75
Table E.30 – Hospital: Collection areas of structure and lines	75
Table E.31 – Hospital: Expected annual number of dangerous events	76
Table E.32 – Hospital: Risk R_1 – Values of probability P for the unprotected structure	76
Table E.33 – Hospital: Risk R_1 for the unprotected structure (values $\times 10^{-5}$)	77
Table E.34 – Hospital: Risk R_1 for the protected structure according to solution a) (values $\times 10^{-5}$)	78
Table E.35 – Hospital: Risk R_1 for the protected structure according to solution b) (values $\times 10^{-5}$)	78
Table E.36 – Hospital: Risk R_1 for the protected structure according to solution c) (values $\times 10^{-5}$)	79
Table E.37 – Hospital: Cost of loss C_L (unprotected) and C_{RL} (protected)	79
Table E.38 – Hospital: Rates relevant to the protection measures	80
Table E.39 – Hospital: Cost C_P and C_{PM} of protection measures (values in \$)	80
Table E.40 – Hospital: Annual saving of money (values in \$)	80
Table E.41 – Apartment block: Environment and global structure characteristics	81
Table E.42 – Apartment block: Power line	82
Table E.43 – Apartment block: Telecom line	82
Table E.44 – Apartment block: Factors valid for zone Z_2 (inside the building)	83
Table E.45 – Apartment block: Risk R_1 for the apartment block depending on protection measures	84

Foreword

This document (EN 62305-2:2012) consists of the text of IEC 62305-2:2010 prepared by IEC/TC 81, "Lightning protection", together with the common modifications prepared by CLC/TC 81X, "Lightning protection".

The following dates are fixed:

- latest date by which this document has to be implemented (dop) 2013-03-19
at national level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2014-01-13

This document supersedes EN 62305-2:2006 + corrigendum November 2006.

EN 62305-2:2012 includes the following significant technical changes with respect to EN 62305-2:2006:

- 1) risk assessment for services connected to structures is excluded from the scope;
- 2) injuries of living beings caused by electric shock inside the structure are considered;
- 3) tolerable risk of loss of cultural heritage is lowered from 10^{-3} to 10^{-4} ;
- 4) extended damage to surroundings structures or to the environment is considered;
- 5) improved formulas are provided for evaluation of
 - collection areas relevant to flashes nearby a structure,
 - collection areas relevant to flashes to and nearby a line,
 - probabilities that a flash can cause damage,
 - loss factors even in structures with risk of explosion,
 - risk relevant to a zone of a structure,
 - cost of loss.
- 6) tables are provided to select the relative amount of loss in all cases;
- 7) impulse withstand voltage level of equipments was extended down to 1 kV.

Notes and tables, which are additional to those in IEC 62305-2:2010 are prefixed "Z".

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Introduction

Lightning flashes to earth may be hazardous to structures and to lines.

The hazard to a structure can result in

- damage to the structure and to its contents,
- failure of associated electrical and electronic systems,
- injury to living beings in or close to the structure.

Consequential effects of the damage and failures may be extended to the surroundings of the structure or may involve its environment.

To reduce the loss due to lightning, protection measures may be required. Whether they are needed, and to what extent, should be determined by risk assessment.

☐ The risk, defined in this part of EN 62305 as the probable average annual loss in a structure due to lightning flashes, depends on ☐

- the annual number of lightning flashes influencing the structure,
- the probability of damage by one of the influencing lightning flashes,
- the mean amount of consequential loss.

Lightning flashes influencing the structure may be divided into

- flashes terminating on the structure,
- flashes terminating near the structure, direct to connected lines (power, telecommunication lines,) or near the lines.

Flashes to the structure or a connected line may cause physical damage and life hazards. Flashes near the structure or line as well as flashes to the structure or line may cause failure of electrical and electronic systems due to overvoltages resulting from resistive and inductive coupling of these systems with the lightning current.

Moreover, failures caused by lightning overvoltages in users' installations and in power supply lines may also generate switching type overvoltages in the installations.

☐ NOTE Malfunctioning of electrical and electronic systems is not covered by the EN 62305 series. Reference should be made to EN 61000-4-5^{[2]1)}. ☐

The number of lightning flashes influencing the structure depends on the dimensions and the characteristics of the structure and of the connected lines, on the environmental characteristics of the structure and the lines, as well as on lightning ground flash density in the region where the structure and the lines are located.

The probability of lightning damage depends on the structure, the connected lines, and the lightning current characteristics, as well as on the type and efficiency of applied protection measures.

The annual mean amount of the consequential loss depends on the extent of damage and the consequential effects which may occur as result of a lightning flash.

The effect of protection measures results from the features of each protection measure and may reduce the damage probabilities or the amount of consequential loss.

The decision to provide lightning protection may be taken regardless of the outcome of risk assessment where there is a desire that there be no avoidable risk.

1) Figures in square brackets refer to the bibliography.

1 Scope

- ☐ This part of EN 62305 is applicable to risk assessment for a structure due to lightning flashes to earth. ☐

Its purpose is to provide a procedure for the evaluation of such a risk. Once an upper tolerable limit for the risk has been selected, this procedure allows the selection of appropriate protection measures to be adopted to reduce the risk to or below the tolerable limit.

2 Normative references

- ☐ The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 62305-1:2011, *Protection against lightning – Part 1: General principles* (IEC 62305-1:2010, mod.)

EN 62305-3:2011, *Protection against lightning – Part 3: Physical damage to structures and life hazard* (IEC 62305-3:2010, mod.)

EN 62305-4:2011, *Protection against lightning – Part 4: Electrical and electronic systems within structures* (IEC 62305-4:2010, mod.) ☐

3 Terms, definitions, symbols and abbreviations

- ☐ For the purposes of this document, the following terms, definitions, symbols and abbreviations, some of which have already been cited in Part 1 but are repeated here for ease of reading, as well as those given in other parts of EN 62305, apply. ☐

3.1 Terms and definitions

3.1.1

structure to be protected

structure for which protection is required against the effects of lightning in accordance with this standard

Note 1 to entry: A structure to be protected may be part of a larger structure.

☐ 3.1.2

structures with risk of explosion

structures containing solid explosives materials or hazardous zones as determined in accordance with EN 60079-10-1^[3] and EN 60079-10-2^[4] ☐

3.1.3

structures dangerous to the environment

structures which may cause biological, chemical or radioactive emission as a consequence of lightning (such as chemical, petrochemical, nuclear plants, etc.)

3.1.4

urban environment

area with a high density of buildings or densely populated communities with tall buildings

Note 1 to entry: 'Town centre' is an example of an urban environment.

3.1.5

suburban environment

area with a medium density of buildings