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PREDSTANDARD**

**OSIST prEN 62305-2:2004**

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Protection against lightning – Part 2: Risk management

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# 81/241/CDV

## COMMITTEE DRAFT FOR VOTE (CDV) PROJET DE COMITÉ POUR VOTE (CDV)

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Also of interest to the following committees Intéresse également les comités suivants SC 37A, TC 64, TC 77		Supersedes documents Remplace les documents 81/213/CD – 81/222A/CC
Functions concerned Fonctions concernées <input checked="" type="checkbox"/> Safety Sécurité <input type="checkbox"/> EMC CEM <input type="checkbox"/> Environment Environnement <input type="checkbox"/> Quality assurance Assurance qualité		

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Titre : CEI 62305-2, Ed. 1: Protection contre la foudre - Partie 2: Evaluation du risque

Title : IEC 62305-2, Ed. 1: Protection against lightning - Part 2: Risk management

Note d'introduction

Introductory note

SIST EN There will be no French version of the CDV.

<https://standards.iteh.ai/catalog/standards/sist/444994b4-badf-432a-acde-115710491220/sist-62305-2-2006>

This document has been prepared based on the decisions taken at the last TC 81 meeting, (see 81/236/RM item 8).

The simplified software for risk management (see Annex J) will be allocated in an IEC FTP server assigned for TC 81 use and will be downloadable by National Committees. Risk assessment performed with the help of this software will be fully in line with procedure and requirements of IEC 62305-2.

<b>ATTENTION</b>	<b>ATTENTION</b>
<b>CDV soumis en parallèle au vote (CEI) et à l'enquête (CENELEC)</b>	<b>Parallel IEC CDV/CENELEC Enquiry</b>

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## Contents

FOREWORD	4
INTRODUCTION	5
1. Scope and object	6
2. Normative references	6
3. Terms and definitions	6
4. Explanation of terms	10
4.1 Damages and loss	10
4.1.1 Source of damage	10
4.1.2 Types of damage	10
4.1.3 Types of loss	11
4.2 Risk and risk components	12
4.2.1 Risk	12
4.2.2 Risk components for a structure due to flashes to the structure	13
4.2.3 Risk component for a structure due to a flash near the structure	13
4.2.4 Risk components for a structure due to flashes to a service connected to the structure	13
4.2.5 Risk component for a structure due to a flash near a service connected to the structure	13
4.2.6 Risk components for a service due to flashes to the service	14
4.2.7 Risk component for a service due to a flash near the service	14
4.2.8 Risk components for a service due to flashes to the structure to which the service is connected	14
4.3 Compositions of risk components related to the structure	14
4.3.1 Composition of risk components with reference to the source of damage (Table 7)	15
4.3.2 Composition of risk components with reference to the type of damage (Table 7)	15
4.4 Compositions of risk components related to the services	16
4.4.1 Composition of risk components with reference to the source of damage (Table 9)	16
4.4.2 Composition of risk components with reference to the type of damage (Table 9)	17
4.5 Factors influencing the risk components	17
4.5.1 Factors influencing the risk components in a structure	17
4.5.2 Factors influencing the risk components in a service	18

5. Risk management	18
5.1 Basic procedure	18
5.2 Structure to be considered for risk assessment	19
5.3 Service to be considered for risk assessment	19
5.4 Tolerable risk $R_T$	19
5.5 Procedure to evaluate the need of protection	19
5.6 Procedure to evaluate the economic convenience of protection	21
5.7 Protection measures	22
5.8 Selection of protection measures	22
6. Assessment of risk components for structures	24
6.1 Basic equation	24
6.2 Assessment of the risk components due to flashes to the structure	25
6.3 Assessment of the risk component due to flash near the structure	25
6.4 Assessment of risk components due to flashes to incoming line	25
6.5 Assessment of risk component due to flash near an incoming line	25
6.6 Summary of risk components in a structure	27
6.7 Partitioning of a structure in zones $Z_S$	27
7. Assessment of risk components for services	28
7.1 Basic equation	28
7.2 Assessment of risk components due to flashes to the service	28
7.3 Assessment of risk component due to flashes near the service	28
7.4 Assessment of risk components due to flashes to the structure to which the service is connected	28
7.5 Summary of risk components in a service	29
7.6 Partitioning of a service in sections $S_S$	30
Annex A (informative) Assessment of annual number $N$ of dangerous events	31
Annex B (informative) Assessment of probability $P$ of damage for a structure	37
Annex C (informative) Assessment of amount of loss $L$ for a structure	42
Annex D (informative) Assessment of probability $P'$ of damage for a service	47
Annex E (informative) Assessment of amount of loss $L'$ for a service	51
Annex F (informative) Switching overvoltages	53
Annex G (informative) Evaluation of costs of loss	54
Annex H (informative) Case study for structures	55
Annex I (informative) Case study for services	81
Annex J (informative) Simplified software for risk assessment	87
Annex K (informative) List of Acronyms / Symbols	92

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PROTECTION AGAINST LIGHTNING –****Part 1: Risk management**

## FOREWORD

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International Standard IEC 62305-2 has been prepared by IEC technical committee 81: Protection against lightning.

The text of this standard is based on the following documents:

FDIS	Report on voting
81/XX/FDIS	81/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until \_\_\_\_\_. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

## INTRODUCTION

Lightning flashes to earth are hazardous to structures and to services.

. The hazard to structure can result in:

- damages to the structure and to its contents
- failures of associated electrical and electronic systems
- injuries of living beings in or close to the structure

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

The hazard to services can result in:

- damages to the service itself
- failures of associated electrical and electronic equipment.

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 standard as the probable average annual loss in a structure and in a service due to lightning flashes, depends on:

- the annual number of lightning flashes influencing the structure and the service,
- 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 striking the structure
- flashes striking near the structure and/or near the connected services (power, telecommunication lines, other services).

Lightning flashes influencing the service may be divided into:

- flashes striking the service
- flashes striking near the service or direct to a structure connected to the service.

Flashes striking the structure or the connected services may cause physical damages and life hazards. Flashes striking near the structure or service as well as flashes to the structure or service may cause failures 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 1 - Malfunctioning of electrical and electronic systems is not covered by IEC 62305 series. Reference should be made to Publication IEC 61000-4-5.

NOTE 2 – Information on assessment the risk due to switching overvoltages is reported in Annex F.

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

The probability of lightning damages depends on the structure and the service and the lightning current characteristics as well as on the kind and efficiency of applied protection measures.

The annual mean amount of the consequential loss depends on the extent of damages 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 assessment of the risk due to all possible effects of lightning flashes to structures and services is presented in this document being a revised version of IEC 61662: 1995-04 and A1: 1996-05 TR 2, Ed. 1.

## PROTECTION AGAINST LIGHTNING –

### Part 1: Risk management

#### 1. Scope and object

This part of IEC 62305 is applicable to risk assessment in a structure or in a service due to lightning flashes to ground.

The scope of this part of IEC 62305 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 at or below the tolerable limit.

#### 2. Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were intended to substitute the ones indicated within brackets ( ); the latter are valid until the issuing of the former. All normative documents are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

*IEC 60364 series: Electrical installations of buildings;*

*IEC 60479 series: Effects of current on human beings and livestock;*

*IEC 61643-1: 1998, Surge protective devices connected to low voltage power distribution systems. Part 1 : performance, requirements and testing methods.*

*IEC 61643-12: 2001, Surge protective devices connected to low voltage power distribution systems. Part 12 : selection and application principles.*

*IEC 62305-1 : Protection against lightning. Part 1: General principles*

*IEC 62305-3: Protection against lightning. Part 3: Physical damages and life hazard in structures.*

*IEC 62305-4 : Protection against lightning. Part 4: Electrical and electronic systems within structures.*

*IEC 62305-5 : Protection against lightning. Part 5: Services*

#### 3. Terms and definitions

For the purpose of this part of IEC 62305, the following definitions as well as those given in other parts of IEC 62305 apply:

##### 3.1 Object to be protected

Structure or service to be protected against the effects of lightning.

##### 3.2 Structure to be protected

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

NOTE - A structure to be protected may be a part of a larger structure.

##### 3.3 Structures with risk of explosion

Structures containing hazardous zones as determined in IEC 60079-10.

NOTE - For the purposes of IEC 62305-2 only structures with hazardous zones type 0 or containing solid explosive materials are considered.

##### 3.4 Structures dangerous to the environment



Structures which may cause biological, chemical and radioactive emission as a consequence of lightning; such as chemical, petrochemical, nuclear plants, etc.

### 3.5 Urban environment

Area with high density of buildings of densely populated communities with tall buildings.

NOTE – Town centre is an example of urban environment.

### 3.6 Suburban environment

Area with medium density of buildings.

NOTE – Town outskirts is an example of suburban environment.

### 3.7 Rural environment

Area with low density of buildings.

NOTE – Countryside is an example of rural environment.

### 3.8 Rated impulse withstand voltage ( $U_w$ )

An impulse withstand voltage assigned by the manufacturer to the equipment or to a part of it, characterising the specified withstand capability of its insulation against overvoltages [definition 1.3.9.2 of IEC 60664-1].

NOTE – For the purpose of IEC 62305-2 only common mode withstand voltage is considered.

### 3.9 Electrical system

A system incorporating low voltage power supply components and possibly also electronic components.

### 3.10 Electronic system

A system incorporating sensitive electronic components such as communication equipment, computer, control and instrumentation systems, radio systems, power electronic installations.

### 3.11 Internal system

Electrical and electronic systems within a structure.

### 3.12 Service to be protected

A service entering a structure for which protection is required against the effects of lightning in accordance with this standard.

NOTE – The service to be protected is the physical means comprising between:

- the switch telecommunication building and the user's building or two switch telecommunication buildings or two user's buildings, for the telecommunication (TLC) lines;
- the high voltage (HV) substation and the user's building, for the power lines;
- the main distribution station and the user's building, for pipes.

### 3.13 Telecommunication lines

Transmission medium intended for communication between equipment that may be located in separate structures, such as phone line and data line.

### 3.14 Power lines

Transmission lines feeding electrical energy into a structure to power electrical and electronic equipment located there, such as Low Voltage (LV) or High Voltage (HV) electric mains.

**3.15 Pipes**

Piping intend to convey a fluid into or out of a structure, such as gas pipe, water pipe, oil pipe.

**3.16 Dangerous event**

A lightning flash striking the object to be protected or near the object to be protected.

**3.17 Lightning flash to an object**

Lightning flash striking an object to be protected.

**3.18 Lightning flash near an object**

Lightning flash striking close enough to an object to be protected that it may cause dangerous overvoltages.

**3.19 Frequency of lightning flashes to a structure ( $N_D$ )**

Expected annual number of lightning flashes to a structure.

**3.20 Frequency of lightning flashes to a service ( $N_L$ )**

Expected annual number of lightning flashes to a service.

**3.21 Frequency of lightning flashes near a structure ( $N_M$ )**

Expected annual number of lightning flashes near a structure.

**3.22 Frequency of lightning flashes near a service ( $N_I$ )**

Expected annual number of lightning flashes near a service.

**3.23 Lightning electromagnetic impulse (LEMP)**

Electromagnetic effects of lightning current.

NOTE – It includes conducted surges as well as radiated impulse electromagnetic field effects.

**3.24 Surges**

Transient wave appearing as overvoltages and /or overcurrents.

NOTE – Surges caused by LEMP can arise from (partial) lightning currents, from induction effects into installation loops and as remaining threat downstream of SPD.

**3.25 Physical damage**

Damage to structure or to its contents due to mechanical, thermal, chemical and explosive effects of lightning.

**3.26 Injuries of living beings**

Injuries, including loss of life, to people or to animals due to touch and step voltages caused by lightning.

**3.27 Failure of electrical and electronic system**

Permanent damage of electrical and electronic system due to LEMP

**3.28 Failure current ( $I_a$ )**

Minimum peak value of lightning current that will cause damage in a line.

**3.29 Probability of damage**

Probability that a lightning flash cause a damage to the object to be protected.

**3.30 Loss**

Mean amount of loss (humans and goods) consequent to a specified type of damage due to a dangerous event, relative to the value (humans and goods) of the object to be protected.

**3.31 Risk (R)**

Measure of probable annual loss (humans and goods) due to lightning, relative to the value (humans and goods) of the object to be protected.

**3.32 Risk component ( $R_x$ )**

Partial risk depending on the source and the type of damage.

**3.33 Tolerable risk ( $R_T$ )**

Maximum value of the risk which can be tolerated for the object to be protected.

**3.34 Zone of a structure ( $Z_S$ )**

Part of a structure with homogeneous characteristics where only one set of parameters is involved in assessment of a risk component.

**3.35 Section of a service ( $S_S$ )**

Part of a service with homogeneous characteristics where only one set of parameters is involved in assessment of a risk component.

**3.36 Lightning Protection Zone (LPZ)**

Zone where the lightning electromagnetic environment is defined.

**3.37 Lightning protection level (LPL)**

Number related to a set of lightning current parameters values relevant to the probability that the associated maximum and minimum design values will not be exceeded in naturally occurring lightning.

NOTE Lightning protection level is used to design protection measures according to the relevant set of lightning current parameters.

**3.38 Protection measures**

Measures to be adopted in the object to be protected to reduce the risk due to lightning.

**3.39 Lightning protection system (LPS)**

Complete system used to reduce physical damages due to lightning flashes striking a structure. It consists of both external and internal lightning protection systems.

**3.40 LEMP protection system (LPM)**

Complete system of protection measures for internal systems against LEMP.

### 3.41 Shielding wire

Metallic wire used to reduce physical damages due to lightning flashes striking a service.

### 3.42 Magnetic shield

Closed metallic grid-like or continuous screen enveloping the object to be protected, or part of it, to reduce failures of electrical and electronic systems.

### 3.43 Lightning cable

Shielded cable specially designed and constructed to reduce the electromagnetic effects of lightning current flowing into the shield

### 3.44 Surge protective device (SPD)

Device that is intended to limit transient overvoltages and divert surge currents. It contains at least one non linear component.

[definition 3.1 of IEC 61643-1].

### 3.45 Surge protective devices set (SPD set)

A set of SPD properly selected, co-ordinated and installed to reduce failures of electrical and electronic systems.

## 4. EXPLANATION OF TERMS

### 4.1 Damages and loss

#### 4.1.1 Source of damage

The lightning current is the primary source of damage. The following sources are distinguished depending on the position of the point struck by flash (see Table 1):

- S1: flashes to a structure,
- S2: flashes near a structure,
- S3: flashes to a service,
- S4: flashes near a service.

#### 4.1.2 Types of damage

A lightning flash may cause damages depending on the characteristics of the object to be protected; among the most important are: type of construction, contents and application, type of service and protection measures provided.

For practical applications of the risk assessment it is useful to distinguish between three basic types of damages, which can appear as the consequence of lightning flash. They are as follows (see Figure 1):

- D1 : Injuries to living beings;
- D2 : Physical damages ;
- D3 : Failures of electrical and electronic systems.

The damage to a structure due to lightning may be limited to a part of the structure or may extend to the whole structure. It may also involve surrounding structures or the environment (e.g. chemical or radioactive emissions).

Lightning affecting a service can cause damage to the physical mean itself – line or pipe- used to provide the service as well as to related electrical and electronic systems. The damage may also extend to internal systems connected to the service.

#### 4.1.3 Types of loss

Each type of damage, alone or in combination with others, may produce a different consequential loss in the object to be protected. The type of loss that may appear depends on the characteristics of the object itself and its content. The following types of loss shall be taken into account (see Table1):

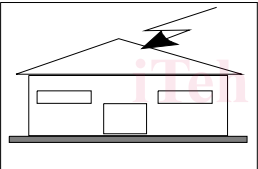
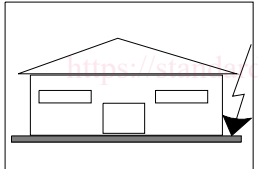
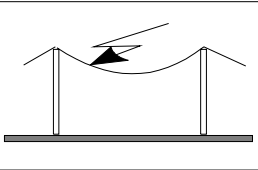
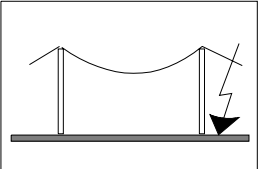
- L1: Loss of human life;
- L2: Loss of service to the public;
- L3: Loss of cultural heritage;
- L4: Loss of economic value (structure and its content, service and loss of activity).

Loss which may appear in a structure are:

- L1: Loss of human life;
- L2: Loss of service to the public;
- L3: Loss of cultural heritage;
- L4: Loss of economic value (structure and its content).

Loss which may appear in a service are:

- L2: Loss of service to the public;
- L4: Loss of economic value (service and loss of activity).

Point of strike	Source of damage	STRUCTURE		SERVICE	
		Type of damage	Type of loss	Type of damage	Type of loss
	S1	D1 D2 D3	L1, L4** L1, L2, L3, L4 L1*, L2, L4	D2 D3	L1***, L2, L4 L2, L4
	S2	D3	L1*, L2, L4		
	S3	D1 D2 D3	L1, L4** L1, L2, L3, L4 L1*, L2, L4	D2 D3	L1***, L2, L4 D2, D4
	S4	D3	L1*, L2, L4	D3	L2, L4

(\*) In the case of hospitals and of structures with risk of explosion;  
 (\*\*) In the case of agricultural properties (loss of animals)  
 (\*\*\*) In the case of pipelines, with not metallic gasket on flanges, conveying explosive fluid.

**Table 1 – Sources of damages (S1, S2, S3, S4), types of damages (D1, D2, D3) and types of loss (L1, L2, L3, L4) selected according to the point of strike**

<b>Loss</b>	<b>L1 Loss of human life</b>	<b>L2 Loss of service the public</b>	<b>L3 Loss of cultural heritage</b>	<b>L4 Loss of economic values</b>
<b>Damage</b>				
<b>D1 Shock of living beings</b>	$R_S$	–	–	$R_S^{(1)}$
<b>D2 Physical damage</b>	$R_F$	$R_F$	$R_F$	$R_F$
<b>D3 Failure of Electric or Electronic systems</b>	$R_O^{(2)}$	$R_O$	–	$R_O$
<p>1 - Only for properties of agricultural with possible loss of animals.</p> <p>2 – Only for hospitals or other structures, where failures on internal systems immediately endanger human life.</p> <p><a href="https://standards.iteh.ai/catalog/standards/sist/444994b4-badf-432a-acde-1c1571049daf/sist-en-62305-2-2006">https://standards.iteh.ai/catalog/standards/sist/444994b4-badf-432a-acde-1c1571049daf/sist-en-62305-2-2006</a></p>				

**Table 2 – Risk in a structure for each type of damage and of loss**

## 4.2 Risk and risk components

### 4.2.1 Risk

The risk **R** is the measure of a loss. For each type of loss which may appear in a structure or in a service, the relevant risk shall be evaluated.

The risks to be evaluated in a structure may be:

- $R_1$ : Risk of loss of human life;
- $R_2$ : Risk of loss of service to the public;
- $R_3$ : Risk of loss of cultural heritage;
- $R_4$ : Risk of loss of economic value.

The risks to be evaluated in a service may be:

- $R'_1$ : Risk of loss of human life;
- $R'_2$ : Risk of loss of service to the public;

- **R'<sub>4</sub>**: Risk of loss of economic value.

To evaluate risks **R** the relevant risk components (partial risks depending on the source and on the type of damage) shall be defined and calculated.

Each risk **R** is the sum of its risk components. In making addition the risk components may be grouped according to the source of damage and the type of damage.

#### 4.2.2 Risk components for a structure due to flashes to the structure

- R<sub>A</sub>**: component related to injuries of living beings caused by touch and step voltages in the zones up to 3 m outside the structure. Loss of type L1 and, in the case of agricultural properties, also loss L4 with possible loss of animals may arise;

NOTE - The risk component caused by touch and step voltages inside the structure due to flashes to the structure is not considered in this Standard.

- R<sub>B</sub>**: component related to physical damages caused by dangerous sparking inside the structure triggering fire or explosion, which may also endanger the environment. All types of loss (L1, L2, L3, L4) may arise;

- R<sub>C</sub>**: component related to failure of internal systems caused by LEMP. Loss are of type L2 and L4 could occur in all cases, along with type L1 in the case of structures with risk of explosion and hospitals or other structures where failure of internal systems immediately endangers human life;

#### 4.2.3 Risk component for a structure due to a flash near the structure

- R<sub>M</sub>**: component related to failure of internal systems caused by LEMP. Loss are of type L2 and L4 could occur in all cases, along with type L1 in the case of structures with risk of explosion and of hospitals or other structures where failure of internal systems immediately endangers human life.

#### 4.2.4 Risk components for a structure due to flashes to a service connected to the structure

- R<sub>U</sub>**: component related to injuries of living beings caused by touch voltage inside the structure, due to lightning current injected in a line entering the structure. Loss of type L1 and, in the case of agricultural properties, also loss L4 with possible loss of animals could occur;

- R<sub>V</sub>**: component related to physical damages (fire or explosion triggered by dangerous sparking between external installation and metallic parts generally at the entrance point of the line into the structure) due to lightning current transmitted through or along incoming services. All types of loss (L1, L2, L3, L4) may occur;

- R<sub>W</sub>**: component related to failure of internal systems caused by overvoltages induced on incoming lines and transmitted to the structure. Loss are of type L2 and L4 could occur in all cases, along with type L1 in the case of structures with risk of explosion and of hospitals or other structures where failure of internal systems immediately endangers human life;

NOTE – Lightning flashes to or near pipes, do not cause damages to the structure, provided they are bonded to the equipotential bonding bar of the structure. Therefore such a source of damage is not considered in the assessment of risk for structures and the services to be taken into account are only the lines entering the structure.

#### 4.2.5 Risk component for a structure due to a flash near a service connected to the structure

- R<sub>Z</sub>**: component related to failure of internal systems caused by overvoltages induced on incoming lines and transmitted to the structure. Loss are of type L2 and L4 could occur in all cases, along with type L1 in the case of structures with risk of explosion and hospitals or other structures where failure of internal systems immediately endanger human life;

NOTE – Lightning flashes to or near pipes, do not cause damages to the structure, provided they are bonded to the equipotential bonding bar of the structure. Therefore such a source of damage is not considered in the assessment of risk for structures and the services to be taken into account are only the lines entering the structure.