

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Protection against lightning –
Part 1: General principles**

**Protection contre la foudre –
Partie 1: Principes généraux**

[IEC 62305-1:2024](https://standards.iteh.ai/catalog/standards/iec/1ff4fb66-8a9a-4fc2-972f-e44f4c7f547c/iec-62305-1-2024)

<https://standards.iteh.ai/catalog/standards/iec/1ff4fb66-8a9a-4fc2-972f-e44f4c7f547c/iec-62305-1-2024>





THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2024 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications, symboles graphiques et le glossaire. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 500 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 25 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.



INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Protection against lightning –
Part 1: General principles**

**Protection contre la foudre –
Partie 1: Principes généraux**

[IEC 62305-1:2024](https://standards.iteh.ai/standards/iec/1ff4fb66-8a9a-4fc2-972f-e44f4c7f547c/iec-62305-1-2024)

<https://standards.iteh.ai/catalog/standards/iec/1ff4fb66-8a9a-4fc2-972f-e44f4c7f547c/iec-62305-1-2024>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.020, 91.120.40

ISBN 978-2-8322-8002-7

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	10
2 Normative references	10
3 Terms and definitions	10
4 Lightning current parameters	17
5 Damage due to lightning.....	18
5.1 Damage to a structure	18
5.1.1 General	18
5.1.2 Effects of lightning on a structure	18
5.1.3 Sources and causes of damage to a structure	19
5.2 Types of loss	20
6 Need for lightning protection.....	21
6.1 Risk and frequency	21
6.2 Need for lightning protection for reduction of risk R	22
6.3 Need for lightning protection for reduction of frequency of damage F	22
7 Protection measures.....	23
7.1 General.....	23
7.2 Protection measures to reduce injury to human beings by electric shock.....	23
7.3 Protection measures to reduce physical damage.....	24
7.4 Protection measures to reduce failure of internal systems.....	24
7.5 Protection measures selection	24
8 Basic criteria for protection of structures.....	24
8.1 General.....	24
8.2 Lightning protection levels (LPLs)	25
8.3 Lightning protection zones (LPZs).....	27
8.4 Protection of structures	29
8.4.1 Protection to reduce physical damage and life hazard	29
8.4.2 Protection to reduce the failure of internal systems.....	30
Annex A (informative) Parameters of lightning current	31
A.1 Lightning flashes to earth.....	31
A.2 Lightning current parameters	34
A.3 Fixing the maximum lightning current parameters for LPL I	39
A.3.1 General	39
A.3.2 First positive stroke and long stroke	39
A.3.3 First negative stroke	40
A.3.4 Subsequent stroke.....	40
A.4 Fixing the minimum lightning current parameters	40
Annex B (informative) Time functions of the lightning current for analysis purposes.....	42
Annex C (informative) Simulation of the lightning current for test purposes.....	47
C.1 General.....	47
C.2 Simulation of the specific energy of the first positive stroke and the charge of the long stroke	47
C.3 Simulation of the front current steepness of the impulses.....	48

Annex D (informative) Test parameters simulating the effects of lightning current on LPS components.....	51
D.1 General.....	51
D.2 Current parameters relevant to the point of strike.....	51
D.3 Current sharing.....	52
D.4 Effects of lightning current causing possible damage.....	53
D.4.1 Thermal effects.....	53
D.4.2 Mechanical effects.....	57
D.4.3 Combined effects.....	61
D.4.4 Sparking.....	61
D.4.5 Soil ionization.....	61
D.5 LPS components, relevant problems and test parameters.....	61
D.5.1 General.....	61
D.5.2 Air terminations.....	61
D.5.3 Down conductors.....	62
D.5.4 Connecting components.....	63
D.5.5 Earth terminations.....	64
D.6 Surge protective devices (SPDs).....	64
D.6.1 General.....	64
D.6.2 SPD containing spark gaps.....	64
D.6.3 SPD containing metal-oxide varistors.....	65
D.7 Summary of the test parameters to be adopted in testing LPS components.....	66
Annex E (informative) Surge currents due to lightning at different installation points.....	67
E.1 General.....	67
E.2 Surge currents due to flashes to the structure (source of damage S1).....	67
E.2.1 Surge currents flowing through external conductive parts and lines connected to the structure.....	67
E.2.2 Factors influencing the sharing of the lightning current and related charge in power lines.....	67
E.2.3 Surge currents flowing through line conductors connected to the structure.....	68
E.2.4 Surge currents flowing through conductive parts and cables internal to the structure connected to LPS.....	69
E.2.5 Surge currents flowing through cables connected to different points of the earth-termination system within the same earth-termination system.....	70
E.3 Surge currents due to flashes to lines (source of damage S3).....	70
E.4 Surges due to flashes near the lines (source of damage S4).....	71
E.5 Surge currents due to induction effects (sources of damage S1 or S2).....	71
E.5.1 General.....	71
E.5.2 Surges inside an unshielded LPZ 1.....	72
E.5.3 Surges inside shielded LPZs.....	72
E.6 Conventional surge currents.....	72
Bibliography.....	75
Figure 1 – Connection between the various parts of the IEC 62305 series.....	9
Figure 2 – LPZ defined by an LPS (IEC 62305-3).....	28
Figure 3 – LPZ defined by LPS and SPM (IEC 62305-4).....	29
Figure A.1 – Definitions of impulse current parameters according to IEC 62475 [7].....	31
Figure A.2 – Definitions of long duration stroke parameters.....	32

Figure A.3 – Schematic representation (not to scale) of possible components of downward flashes (typical in flat territory and to lower structures) and multiple strokes downward flashes 32

Figure A.4 – Schematic representation (not to scale) of possible components of upward flashes (typical of exposed or higher structures or both) 33

Figure A.5 – Cumulative frequency distribution of lightning current parameters (dotted line through 50 % value) 38

Figure B.1 – Shape of the current rise of the first positive stroke 43

Figure B.2 – Shape of the current tail of the first positive stroke 43

Figure B.3 – Shape of the current rise of the first negative stroke 44

Figure B.4 – Shape of the current tail of the first negative stroke 44

Figure B.5 – Shape of the current rise of the subsequent negative strokes 45

Figure B.6 – Shape of the current tail of the subsequent negative strokes 45

Figure B.7 – Amplitude density of the lightning current according to LPL I 46

Figure C.1 – Example test generator for the simulation of the specific energy of the first positive stroke and the charge of the long stroke 48

Figure C.2 – Definition of the current steepness in accordance with Table C.3 49

Figure C.3 – Example test generator for the simulation of the front steepness of the first positive stroke for large test items 49

Figure C.4 – Example test generator for the simulation of the front steepness of the subsequent negative strokes for large test items 50

Figure D.1 – General arrangement of two conductors for the calculation of electrodynamic force 58

Figure D.2 – Typical conductor arrangement in an LPS 59

Figure D.3 – Diagram of the stresses F for the configuration of Figure D.2 59

Figure D.4 – Force per unit length F' along the horizontal conductor of Figure D.2 60

Table 1 – Effects of lightning on typical structures 19

Table 2 – Sources of damage, causes of damage, types of loss according to the point of strike 21

Table 3 – Maximum values of lightning parameters according to LPLs 26

Table 4 – Minimum values of lightning parameters and related rolling sphere radius corresponding to LPLs 26

Table 5 – Probabilities for the limits of the lightning current parameters 26

Table A.1 – Tabulated values of lightning current parameters (CIGRE [9], [10], [11]) 35

Table A.2 – Logarithmic normal distribution of lightning current parameters – Mean μ and dispersion σ_{\log} calculated from 5 % and 95 % values (CIGRE [9], [10], [11]) 36

Table A.3 – Values of probability P as function of the lightning current I peak value 37

Table B.1 – Parameters for Equation (B.1) 42

Table C.1 – Test parameters of the first positive stroke 48

Table C.2 – Test parameters of the long stroke 48

Table C.3 – Test parameters of the strokes 49

Table D.1 – Summary of the lightning threat parameters to be considered in the calculation of the test values for the different LPS components and for the different LPLs 52

Table D.2 – Physical characteristics of typical materials used in LPS components 55

Table D.3 – Temperature rise for conductors of different sections as a function of W/R	55
Table E.1 – Conventional surge currents due to lightning flashes on low-voltage systems	73
Table E.2 – Conventional surge currents due to lightning flashes on telecommunication systems	74

iTeh Standards
(<https://standards.itih.ai>)
Document Preview

[IEC 62305-1:2024](#)

<https://standards.itih.ai/catalog/standards/iec/1ff4fb66-8a9a-4fc2-972f-e44f4c7f547c/iec-62305-1-2024>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PROTECTION AGAINST LIGHTNING –

Part 1: General principles

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 62305-1 has been prepared by IEC technical committee 81: Lightning protection. It is an International Standard.

This third edition cancels and replaces the second edition published in 2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) reference to the IEC 62561 series [1]¹ is made in Annex D to provide a link to relevant lightning protection system components according to the IEC 62561 series;

¹ Numbers in square brackets refer to the Bibliography.

- b) risk management introduces the concept of types of loss with public relevance;
- c) the concept of frequency of damage that can impair the availability of the internal systems within the structure has been introduced;
- d) surge currents due to lightning flashes have been more accurately specified for SPD dimensioning in low-voltage power systems and in telecommunication systems.

The text of this International Standard is based on the following documents:

Draft	Report on voting
81/737/FDIS	81/756/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62305 series, published under the general title *Protection against lightning*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

[IEC 62305-1:2024](#)

<https://standards.iteh.ai/catalog/standards/iec/1ff4fb66-8a9a-4fc2-972f-e44f4c7f547c/iec-62305-1-2024>

INTRODUCTION

There are no devices or methods capable of modifying the natural weather phenomena to the extent that they can prevent lightning discharges. Lightning flashes to, or nearby, structures (or lines connected to the structures) are hazardous to people, to the structures themselves, their contents and installations as well as to lines. This is why the application of lightning protection measures is essential.

The need for protection, the economic benefits of installing protection measures, and the selection of adequate protection measures should be determined in terms of risk management. Risk management is the subject of IEC 62305-2 [2].

NOTE In Germany, the need for lightning protection is determined by, and the class of required LPS shall be selected according to, a national annex to the third edition of IEC 62305-1 (including an option for a risk assessment following the third edition of IEC 62305-2).

Protection measures considered in the IEC 62305 series have been proven to be effective in risk reduction.

All measures for protection against lightning form the overall lightning protection. For practical reasons the criteria for design, installation and maintenance of lightning protection measures are considered in two separate groups:

- the first group concerning protection measures to reduce physical damage and life hazard in a structure is given in IEC 62305-3;
- the second group concerning protection measures to reduce failures of electrical and electronic systems in a structure is given in IEC 62305-4.

The connection between the parts of the IEC 62305 series is illustrated in Figure 1.

NOTE The implementation of an IEC 62793 [3] compliant TWS in the protection measures for a structure can assist in reducing physical damage, life hazard, and failure of electrical and electronic systems.

[IEC 62305-1:2024](https://standards.iteh.ai/catalog/standards/iec/1ff4fb66-8a9a-4fc2-972f-e44f4c7f547c/iec-62305-1-2024)

<https://standards.iteh.ai/catalog/standards/iec/1ff4fb66-8a9a-4fc2-972f-e44f4c7f547c/iec-62305-1-2024>

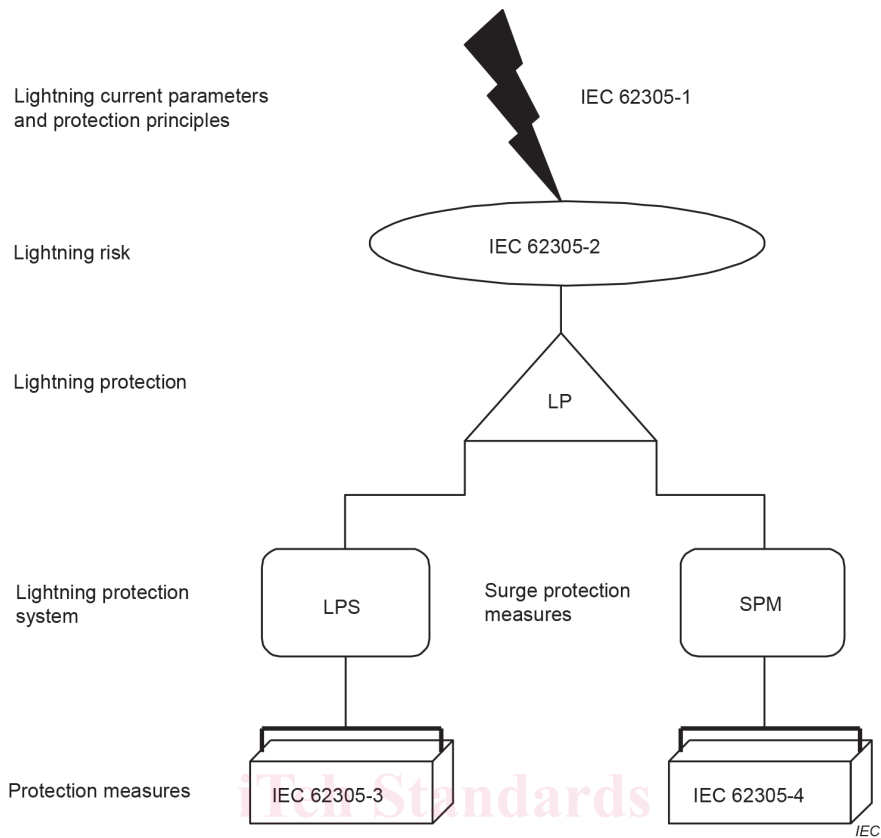


Figure 1 – Connection between the various parts of the IEC 62305 series

[IEC 62305-1:2024](https://standards.iteh.ai/catalog/standards/iec/1ff4fb66-8a9a-4fc2-972f-e44f4c7f547c/iec-62305-1-2024)

<https://standards.iteh.ai/catalog/standards/iec/1ff4fb66-8a9a-4fc2-972f-e44f4c7f547c/iec-62305-1-2024>

PROTECTION AGAINST LIGHTNING –

Part 1: General principles

1 Scope

This part of IEC 62305 provides general principles for the protection of structures against lightning, including their installations and contents, as well as persons.

The following cases are outside the scope of this document:

- railway systems;
- vehicles, ships, aircraft, offshore installations;
- underground high-pressure pipelines;
- pipe, power and telecommunication lines separated from the structure;
- nuclear power plants.

The IEC 62305 series should be considered as a minimum requirement for these structures.

Until any further information by CIGRE is available the lightning current parameters described in this document can be applied also for offshore installations.

NOTE 1 In these cases, structures usually fall under special regulations produced by various specialized authorities. For structures (subsidiary or others) not falling under such special regulations, the IEC 62305 series still applies.

NOTE 2 Lightning protection of wind turbines is also covered by IEC 61400-24 [4].

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62305-3:2024, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

IEC 62305-4:2024, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1**lightning flash to earth**

electrical discharge of atmospheric origin between cloud and earth consisting of one or more strokes

3.2**downward flash**

lightning flash initiated by a downward leader from cloud to earth

Note 1 to entry: A downward flash consists of a first current short stroke, which can be followed by other subsequent short strokes. One or more short strokes can be also followed by a long stroke.

3.3**upward flash**

lightning flash initiated by an upward leader from an earthed structure to cloud

Note 1 to entry: An upward flash consists of a first long stroke with or without multiple superimposed impulses. One or more impulses can be followed by a long stroke.

3.4**lightning stroke**

single electrical discharge in a lightning flash to earth

3.5**short stroke**

part of the lightning flash which corresponds to an impulse current

Note 1 to entry: The impulse current has a time T_2 to the half peak value on the tail typically less than 2 ms (see Figure A.1).

3.6**long stroke**

part of the lightning flash which corresponds to a continuing current

Note 1 to entry: The duration time T_{LONG} of this continuing current is typically more than 2 ms and less than 1 s (see Figure A.2).

3.7**multiple strokes lightning flash**

lightning flash consisting on average of three to four strokes, with a typical time interval between them of about 50 ms

Note 1 to entry: Events having up to a few dozen strokes with intervals between them ranging from 10 ms to 250 ms have been reported.

3.8**point of strike**

point where a lightning flash strikes the earth or a structure (e.g. building, LPS, line, tree)

Note 1 to entry: A lightning flash can have more than one point of strike.

3.9**lightning current**

i

current flowing at the point of strike

3.10**current peak value**

I

maximum value of the lightning current

**3.11
average steepness of the current front** di/dt maximum current of the impulse I divided by the front time of the impulse T_1

Note 1 to entry: See 3.10 and 3.12 and Figure A.1.

**3.12
front time of impulse current** T_1

virtual parameter defined as 1,25 times the time interval between the instants when the 10 % and 90 % of the peak value are reached

SEE: Figure A.1.

**3.13
virtual origin of impulse current** O_1 point of intersection with the time axis of a straight line drawn through the 10 % and the 90 % reference points on the stroke current front preceding by 0,1 T_1 that instant at which the current attains 10 % of its peak value

SEE: Figure A.1.

**3.14
time to half value on the tail of impulse current** T_2 virtual parameter defined as the time interval between the virtual origin O_1 and the instant at which the current has decreased to half the peak value on the tail

SEE: Figure A.1.

**3.15
flash duration** T

time for which the lightning current flows at the point of strike

**3.16
duration of long stroke current** T_{LONG}

time duration during which the current in a long stroke is between 10 % of the peak value during the increase of the continuing current and 10 % of the peak value during the decrease of the continuing current

SEE: Figure A.2.

**3.17
flash charge** Q_{FLASH}

value resulting from the time integral of the lightning current for the entire lightning flash duration

**3.18
short stroke charge** Q_{SHORT}

value resulting from the time integral of the lightning current in an impulse