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INTERNATIONAL STANDARD

NORME INTERNATIONALE

BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

Fire hazard testing –
Part 1-12: Guidance for assessing the fire hazard of electrotechnical products – Fire safety engineering

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Essais relatifs aux risques du feu –
Partie 1-12: Lignes directrices pour l'évaluation des risques du feu des produits électrotechniques – Ingénierie de la sécurité incendie

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FIRE HAZARD TESTING –

Part 1-12: Guidance for assessing the fire hazard of electrotechnical products – Fire safety engineering

FOREWORD

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International Standard IEC 60695-1-12 Ed 1.0 has been prepared by IEC technical committee 89: Fire hazard testing.

It has the status of a basic safety publication in accordance with IEC Guide 104 and ISO/IEC Guide 51.

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

FDIS	Report on voting
89/1237A/FDIS	89/1242/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.

A list of all the parts in the 60695 series, under the general title *Fire hazard testing*, can be found on the IEC web site.

IEC 60695-1 consists of the following parts:

Part 1-10: Guidance for assessing the fire hazard of electrotechnical products – General guidelines

Part 1-11: Guidance for assessing the fire hazard of electrotechnical products – Fire hazard assessment

Part 1-12: Guidance for assessing the fire hazard of electrotechnical products – Fire safety engineering

Part 1-30: Guidance for assessing the fire hazard of electrotechnical products – Preselection testing process – General guidelines

Part 1-40: Guidance for assessing the fire hazard of electrotechnical products – Insulating liquids.

This standard is to be used in conjunction with IEC 60695-1-10 and IEC 60695-1-11.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
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INTRODUCTION

Fire safety engineering

Fire safety engineering concerns the application of engineering methods based on scientific principles to the development or assessment of designs in the built environment through the analysis of specific fire scenarios or through the quantification of risk for a group of fire scenarios. This is in order to achieve fire safety engineering objectives, which typically are:

a) to protect life safety,

b) to protect property,

c) to maintain the continuity of operations,

d) to protect the natural environment, and

e) to preserve heritage.

The analysis is based on calculations that use input data obtained principally from quantitative fire tests.

Fire safety engineering (FSE) is a discipline increasingly being used in support of performance-based national fire safety regulations in many countries and regional jurisdictions throughout the world. The eight parts of ISO/TR 13387 (see Clause 2 and [1] to [6]) and ISO 23932 outline the fundamental methodologies and uses of FSE. Further detailed aspects of FSE are covered in ISO 16730 [7], ISO/TS 16732 [8], ISO/TS 16733, ISO 16734 [9], ISO 16735 [10], ISO 16736 [11], ISO 16737 [12] and ISO/TR 16738.

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In addition to purely performance-based regulations, many countries are also using FSE to supplement prescriptive regulations by applying FSE principles to specific design aspects, where reduced costs, alternative practices, improved performance and improved safety are the objectives.

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The International Maritime Organization (IMO) is using FSE and the ISO standards mentioned above to develop fire safety designs for ships. These are considered to be an improvement on designs based on prescriptive fire safety requirements.

Qualitative and quantitative fire tests

Many standardised fire test methods give information on the performance of a material or end product as measured in the test, which may or may not be related to a real fire scenario or real installation practices. These qualitative fire test methods result in a “pass” or “fail” and/or a product or material ranking. They play an important role in prescriptive regulations, and the results of a qualitative test can be used indirectly in fire hazard assessment of electrotechnical products, but they are not suitable for directly supporting performance-based design.

Most standardized test methods developed by the IEC for electrotechnical products are of the qualitative type. It is agreed within ISO and the IEC that this type of fire test will continue to be maintained and, where necessary, developed. It is recognised that, even if the use of these standards is in prescriptive codes, product data from many of these standards may be potentially adaptable for fire safety engineering purposes.

In contrast, quantitative fire tests are increasingly being used and developed, and these do provide data that can be input to fire safety engineering calculations.

Various quantitative fire tests have been developed by ISO, some of which can be used to assess the performance of electrotechnical products (see 9.4).

FIRE HAZARD TESTING –

Part 1-12: Guidance for assessing the fire hazard of electrotechnical products – Fire safety engineering

1 Scope

This part of IEC 60695 is intended as a general guideline for IEC Product Committees and provides:

- an explanation of the principles and uses of fire safety engineering;
- guidance on the use of fire safety engineering in the design of electrotechnical products;
- fire safety engineering terminology, and concepts;
- an indication of properties, data and tests needed for input into fire safety engineering assessments;
- informative references.

This international standard is not intended to be a detailed technical design guide, but is intended to provide guidance for product committees on fire safety engineering methods and performance based test information needs for use in performance based designs and fire hazard assessments of electrotechnical materials, assemblies, products and systems. More detailed information on fire safety engineering is contained in the ISO/TR 13387 series of documents (see Clause 2 and [1] to [6]) and in ISO 23932.

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ISO/TR 16738:2015
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NOTE Further detailed aspects of FSE are covered in ISO 16730 [7], ISO/TS 16732 [8], ISO/TS 16733, ISO 16734 [9], ISO 16735 [10], ISO 16736 [11], ISO 16737 [12] and ISO/TR 16738.

This basic safety publication is intended for use by technical committees in the preparation of standards in accordance with the principles laid down in IEC Guide 104 and ISO/IEC Guide 51.

One of the responsibilities of a technical committee is, wherever applicable, to make use of basic safety publications in the preparation of its publications. The requirements, test methods or test conditions of this basic safety publication will not apply unless specifically referred to or included in the relevant publications.

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.

IEC 60695-1-10, *Fire hazard testing – Part 1-10: Guidance for assessing the fire hazard of electrotechnical products – General guidelines*

IEC 60695-1-11, *Fire hazard testing – Part 1-11: Guidance for assessing the fire hazard of electrotechnical products – Fire hazard assessment*

IEC 60695-4, *Fire hazard testing – Part 4: Terminology concerning fire tests for electrotechnical products*

IEC Guide 104, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO/IEC Guide 51, *Safety aspects – Guidelines for inclusion in standards*

ISO 13943:2008, *Fire safety – Vocabulary*

ISO/TR 13387-2: *Fire safety engineering – Part 2: Design fire scenarios and design fires*

ISO/TR 13387-8, *Fire safety engineering – Part 8: Life safety: Occupant behaviour, location and condition*

ISO/TS 16733, *Fire safety engineering – Selection of design fire scenarios and design fires*

ISO/TR 16738, *Fire safety engineering – Technical information on methods for evaluating behaviour and movement of people*

ISO/TR 17252:2008, *Fire tests – Applicability of reaction to fire tests to fire modelling and fire safety engineering*

ISO 23932:2009, *Fire safety engineering – General principles*

3 Terms and Definitions

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For the purposes of this document, the terms and definitions given in ISO 13943:2008 and IEC 60695-4:2012, some of which are reproduced below for the user's convenience, as well as the following apply.

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3.1
absorptivity
fraction of the incident radiation that is absorbed by a surface on which it falls

Note 1 to entry: Absorptivity is dimensionless.

3.2
active fire protection
action taken to reduce or prevent the spread and effects of fire in response to the detection of the fire

Note 1 to entry: Examples include the application of agents (e.g. halon gas or water spray) to the fire, or the control of ventilation.

3.3
available safe escape time
ASET
time available for escape
for an individual occupant, the calculated time interval between the time of ignition and the time at which conditions become such that the occupant is estimated to be incapacitated, i.e. unable to take effective action to escape to a safe refuge or place of safety

see also **required safe escape time** (3.40).

Note 1 to entry: The time of ignition can be known, e.g. in the case of a fire model or a fire test, or it may be assumed, e.g. it may be based upon an estimate working back from the time of detection. The basis on which the time of ignition is determined is always stated.

Note 2 to entry: This definition equates incapacitation with failure to escape. Other criteria for ASET are possible. If an alternate criterion is selected, it is necessary that it be stated.

Note 3 to entry: Each occupant can have a different value of ASET, depending on that occupant's personal characteristics.

[SOURCE: ISO 13943:2008, definition 4.20]

3.4
built environment
building or other structure

EXAMPLES (1) Off-shore platforms; (2) civil engineering works, such as tunnels, bridges and mines; and (3) means of transportation, such as motor vehicles and marine vessels.

Note 1 to entry: ISO 6707-1 [13] contains a number of terms and definitions for concepts related to the built environment.

[SOURCE: ISO 13943:2008, definition 4.26]

3.5
compressive strength
maximum uniaxial compressive stress experienced by a material at its moment of rupture

3.6
density
mass per unit volume

3.7
design fire
quantitative description of assumed fire characteristics within the design fire scenario

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Note 1 to entry: It is typically, an idealised description of the variation with time of important fire variables such as heat release rate, flame spread rate, smoke production rate, toxic gas yields, and temperature.

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[SOURCE: ISO 13943:2008, definition 4.64]

3.8
design fire scenario
specific fire scenario on which a deterministic fire-safety engineering analysis is conducted

[SOURCE: ISO 13943:2008, definition 4.65]

3.9
emissivity
ratio of the radiation emitted by a radiant source to the radiation that would be emitted by a black body radiant source at the same temperature

Note 1 to entry: Emissivity is dimensionless.

[SOURCE: ISO 13943:2008, definition 4.75]

3.10
environment
conditions and surroundings that can influence the behaviour of an item or persons when exposed to fire

[SOURCE: ISO 13943:2008, definition 4.80]

3.11
escape
effective action taken to reach a safe refuge or place of safety

[SOURCE: ISO 13943:2008, definition 4.82]

3.12
fire decay
stage of fire development after a fire has reached its maximum intensity and during which the heat release rate and the temperature of the fire are decreasing

[SOURCE: ISO 13943:2008, definition 4.104]

3.13
fire effluent
totality of gases and aerosols, including suspended particles, created by combustion or pyrolysis in a fire

[SOURCE: ISO 13943:2008, definition 4.105]

3.14
fire growth
stage of fire development during which the heat release rate and the temperature of the fire are increasing

[SOURCE: ISO 13943:2008, definition 4.111]

3.15
fire hazard
physical object or condition with a potential for an undesirable consequence from fire

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[SOURCE: ISO 13943:2008, definition 4.112]

3.16
fire hazard assessment

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evaluation of the possible causes of fire, the possibility and nature of subsequent fire growth, and the possible consequences of fire

[SOURCE: IEC 60695-4:2012, definition 3.2.10]

3.17
fire model
fire simulation
calculation method that describes a system or process related to fire development, including fire dynamics and the effects of fire

[SOURCE: ISO 13943:2008, definition 4.116]

3.18
fire resistance
ability of a test specimen to withstand fire or give protection from it for a period of time

Note 1 to entry: Typical criteria used to assess fire resistance in a standard fire test are fire integrity, fire stability, and thermal insulation material.

Note 2 to entry: "Fire resistant" (adj.) refers only to this ability.

[SOURCE: ISO 13943:2008, definition 4.121]

3.19
fire safety design
quantitative description of the construction of a built environment intended to meet fire safety objectives

3.20
fire safety engineering
application of engineering methods based on a scientific principles to the development or assessment of designs in the built environment through the analysis of specific fire scenarios or through the quantification of risk for a group of fire scenarios

[SOURCE: ISO 13943:2008, definition 4.126]

3.21
fire-safety objective
desired outcome with respect to the probability of an unwanted fire, relative to essential aspects of the built environment

Note 1 to entry: The essential aspects typically relate to the issues of life safety, conservation of property, continuity of operations, protection of the environment and preservation of heritage.

[SOURCE: ISO 13943:2008, definition 4.128]

3.22
fire scenario
qualitative description of the course of a fire with respect to time, identifying key events that characterize the studied fire and differentiate it from other possible fires

Note 1 to entry: It typically defines the ignition and fire growth processes, the fully developed fire stage, the fire decay stage, and the environment and systems that impact on the course of the fire.

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[SOURCE: ISO 13943:2008, definition 4.129]

3.23
fire test
test that measures behaviour of a fire or exposes an item to the effects of a fire

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Note 1 to entry: The results of a fire test can be used to quantify fire severity or determine the fire resistance or reaction to fire of the test specimen

[SOURCE: ISO 13943:2008, definition 4.132]

3.24
flame spread
propagation of a flame front

[SOURCE: ISO 13943:2008, definition 4.142]

3.25
fully developed fire
state of total involvement of combustible materials in a fire

[SOURCE: ISO 13943:2008, definition 4.164]

3.26
heat of combustion
DEPRECATED: calorific potential
DEPRECATED: calorific value
thermal energy produced by combustion of unit mass of a given substance

Note 1 to entry: The typical units are kilojoules per gram ($kJ \cdot g^{-1}$).

[SOURCE: ISO 13943:2008, definition 4.174]

3.27
heat of gasification
thermal energy required to change a unit mass of material from the condensed phase to the vapour phase at a given temperature

Note 1 to entry: The typical units are kilojoules per gram ($kJ \cdot g^{-1}$).

[SOURCE: ISO 13943:2008, definition 4.175]

3.28
heat release
thermal energy released by combustion

Note 1 to entry: The typical units are joules (J).

[SOURCE: ISO 13943:2008, definition 4.176]

3.29
heat release rate
DEPRECATED: burning rate
DEPRECATED: rate of burning
rate of thermal energy production generated by combustion

Note 1 to entry: The typical units are watts (W).

[SOURCE: ISO 13943:2008, definition 4.177]

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3.30
ignition
<general> initiation of combustion

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[SOURCE: ISO 13943:2008, definition 4.187]

3.31
modulus of elasticity
ratio of stress to strain within the elastic range of a material, i.e. where Hooke's Law is obeyed

3.32
passive fire protection
action taken to reduce or prevent the spread and effects of fire by means not requiring an action

EXAMPLES (1) The division of a space into compartments using materials with inherent fire resistance to fabricate walls, floors, doors and other barriers. (2) The use of materials with good fire behaviour.

3.33
performance criteria
quantitative criteria, which have been agreed with a building approval authority, and which form an acceptable basis for assessing the safety of a design for a built environment

3.34
performance-based design
design that is engineered to achieve specified objectives and performance criteria

3.35
performance-based regulation
regulation in which compliance is specified in terms of performance criteria

Note 1 to entry: Performance-based regulation is more flexible than prescriptive regulation because it focuses on the overall outcome to be achieved rather than on component hazards.

3.36
prescriptive regulation
regulation in which the means and approach for compliance are completely or mostly specified

Note 1 to entry: Prescriptive regulation is less flexible than performance based regulation because it focuses on component hazards rather than on the overall outcome to be achieved.

Note 2 to entry: Many fire tests were originally developed to provide input for prescriptive regulation. They are often based on simple pass/fail criteria and are usually unable to provide data suitable for input to fire safety engineering.

3.37
qualitative fire test
fire test which is either:

a) a pass/fail test; or

b) a test which categorizes the behaviour of the test specimen by determining its position in a rank order of performance

[SOURCE: IEC 60695-4:2012, definition 3.2.22]

3.38
quantitative fire test
fire test which takes into account the circumstances of product use in which the test conditions are based on, or are relatable to, the circumstances of use of the test specimen, and which measures a parameter or parameters, expressed in well defined terms and using rational scientific units, which can be used in the quantitative assessment of fire risk

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[SOURCE: IEC 60695-4:2012, definition 3.2.23]

3.39
reaction to fire
response of a test specimen when it is exposed to a fire under specified conditions in a fire test

Note 1 to entry: Fire resistance is regarded as a special case and is not normally considered as a reaction to fire property.

[SOURCE: ISO 13943:2008, definition 4.272]

3.40
required safe escape time
RSET
time required for escape
calculated time interval required for an individual occupant to travel from their location at the time of ignition to a safe refuge or place of safety

cf. **available safe escape time** (3.3).

[SOURCE: ISO 13943:2008, definition 4.277]

3.41
smoke
visible part of fire effluent

[SOURCE: ISO 13943:2008, definition 4.293]