# IEC 60695-1-10

Edition 2.0 2016-11
REDLINE VERSION

# INTERNATIONAL STANDARD

colour inside

BASIC SAFETY PUBLICATION

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



IEC 60695-1-10:2016-11 RLV(en)

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## FOREWORD

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**This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.**

International Standard IEC 60695-1-10 has been prepared by IEC technical committee 89: Fire hazard testing.

This second edition cancels and replaces the first edition published in 2009. This edition constitutes a technical revision.

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

a) reference to IEC 60695-1-12;
b) modified Introduction and Scope;
c) updated normative references;
d) updated terms and definitions;
e) modified Table 1;
f) addition of Table 2;
g) new text in Subclauses 5.2, 5.3 and 5.4;
h) mandatory text in Clause 8;
i) Annex B changed to Annex A, and modified;
j) new Annex B concerning common ignition sources.

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

| FDIS | Report on voting |
|---|---|
| 89/1341/FDIS | 89/1347/RVD |



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



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

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

This standard is to be used in conjunction with IEC 60695-1-11 and IEC 60695-1-12.

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

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 1-20: *Guidance for assessing the fire hazard of electrotechnical products – Ignitability – General guidance*

Part 1-21: *Guidance for assessing the fire hazard of electrotechnical products – Ignitability – Summary and relevance of test methods*

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*

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

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

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# INTRODUCTION

In the design of any electrotechnical product, the risk of fire and the potential hazards associated with fire need to be considered. In this respect the objective of component, circuit and ~~product~~ equipment design, as well as the choice of materials, is to reduce ~~to acceptable levels~~ the ~~potential~~ risk~~s~~ of fire to a tolerable level even in the event of reasonably foreseeable ~~abnormal~~ (mis)use, malfunction or failure. This standard, together with its companions, IEC 60695-1-11 and IEC 60695-1-12, provides guidance on how this is to be accomplished.

The use of compartments with fire-resistant boundaries, and the use of detection and suppression systems are important methods for the mitigation of fire risk, but are not dealt with in this standard. Fires involving electrotechnical products can be initiated from external non-electrical sources. Considerations of this nature are dealt with in an overall fire hazard assessment.

The aim of the IEC 60695 series of standards is to save lives and property by reducing the number of fires or reducing the consequences of the fire. This can be accomplished by:

- ~~the primary aims are~~ trying to prevent ignition caused by an electrically energised component part and, in the event of ignition, to confine any resulting fire within the bounds of the enclosure of the electrotechnical product;
- ~~secondary aims include~~ trying to minimise ~~any~~ flame spread beyond the product's enclosure and to minimise the harmful effects of fire effluents including heat, smoke, and toxic or corrosive combustion products.

~~Fires involving electrotechnical products can also be initiated from external non-electrical sources. Considerations of this nature are dealt with in the overall risk assessment.~~



Assessing the fire hazard of electrotechnical products is accomplished by performing fire hazard tests. These tests are divided into two fundamental groups: qualitative fire tests and quantitative fire tests.



Fire testing of electrotechnical products should, whenever possible, be carried out using quantitative fire tests having the following characteristics.

a) The test should take into account the circumstances of product use, i.e. contemplated end-use conditions as well as foreseeable abnormal use. This is because fire conditions that may be hazardous under one set of circumstances will not necessarily pose the same threat under a different set.

b) It should be possible to correlate the test results with the harmful effects of fire effluents referred to above, i.e. the thermal and airborne threats to people and/or property in the relevant end-use situation. This avoids the creation of artificial, and sometimes distorted, performance scales with no clear relationship to fire safety.

c) Recognizing that there are usually multiple contributions to the effects of real fires, the test results should be expressed in well-defined terms and using rational scientific units, so that the product's contribution to the overall fire effects can be quantitatively assessed and compared with that of other products' contributions.

Although quantitative tests are preferred, the characteristics of qualitative fire tests are that they provide pass/fail and classification results. Under certain circumstances it will be appropriate to maintain such qualitative test methods or to develop new ones. This part of IEC 60695-1 establishes the circumstances under which such maintenance or development is appropriate.

# FIRE HAZARD TESTING –

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

## 1 Scope

This part of IEC 60695-1 provides general guidance with respect to fire hazard testing on how to reduce to ~~acceptable~~ a tolerable level~~s~~ the risk of fire and the potential effects of fires involving electrotechnical products. It also serves as a signpost standard to the other guidance publications in the IEC 60695 series.

It does not give guidance on the use of fire-resistant compartment boundaries or on the use of detection and suppression systems for the mitigation of fire risk.

It describes the relationship between fire risk and the potential effects of fire, and provides guidance to IEC product committees on the applicability of qualitative and quantitative fire tests to the fire hazard assessment of electrotechnical products. Details of the calculation of fire risk are not included in the scope of this document.



It emphasises the importance of the scenario approach to fire hazard and risk assessment and discusses criteria intended to ensure the development of technically sound hazard-based fire test methods.

It discusses the different types of fire tests, in particular the nature of qualitative and quantitative fire tests. It also describes the circumstances under which it is appropriate for IEC product committees to maintain or develop qualitative fire tests.

This standard is intended as guidance to IEC committees, and ~~should~~ is to be used with respect to their individual applications.

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 60079-0, *Explosive atmospheres − Part 0: Equipment − General requirements*

~~IEC 60695 (all parts), *Fire hazard testing*~~

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

IEC 60695-1-12, *Fire hazard testing – Part 1-12: Guidance for assessing the fire hazard of electrotechnical products – Fire-safety engineering*

IEC 60695-1-30~~:2008~~, *Fire hazard testing – Part 1-30: Guidance for assessing the fire hazard of electrotechnical products – Preselection testing process – General guidelines*[2]

IEC 60695-4:2012, *Fire hazard testing – Part 4: Terminology concerning fire tests for electrotechnical products*

~~IEC/TS 62441:2006, *Accidentally caused candle flame ignition for audio/video, communication and information technology equipment*~~

IEC Guide 104~~:1997~~, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO/IEC Guide 51~~:1999~~, *Safety aspects – Guidelines for their inclusion in standards*

ISO 13943:2008, *Fire safety – Vocabulary*

~~ISO 197063:2007, *Guidelines for assessing the fire threat to people*~~

## 3 Terms and definitions

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

**3.1**
**fire**
⟨general⟩ process of combustion characterized by the emission of heat and fire effluent and usually accompanied by smoke, flame, glowing or a combination thereof

Note 1 to entry: In the English language, the term “fire” is used to designate three concepts, two of which, *fire* (3.2) and *fire* (3.3), relate to specific types of self-supporting combustion with different meanings and two of them are designated using two different terms in both French and German.

[SOURCE: ISO 13943:2008, 4.96]

**3.2**
**fire**
⟨controlled⟩ self-supporting combustion that has been deliberately arranged to provide useful effects and is limited in its extent in time and space

[SOURCE: ISO 13943:2008, 4.97]

**3.3**
**fire**
⟨uncontrolled⟩ self-supporting combustion that has not been deliberately arranged to provide useful effects and is not limited in its extent in time and space



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~~1 To be published.~~

2 Under preparation. Stage at time of publication: IEC/FDIS 60695-1-30:2016.

~~3 ISO 9122-1, Toxicity testing of fire effluents – Part 1: General, has been withdrawn and replaced by ISO 19706.~~

[SOURCE: ISO/~~IEC~~ 13943:2008, 4.98]

**3.4**
**fire hazard**
physical object or condition with a potential for an undesirable consequence from *fire* (3.3)

[SOURCE: ISO/~~IEC~~ 13943:2008, 4.112]

**3.5**
**fire risk**
probability of a *fire* (3.3) combined with a quantified measure of its consequence

Note 1 to entry: It is often calculated as the product of probability and consequence.

[SOURCE: ISO/~~IEC~~ 13943:2008, 4.124]

**3.6**
**fire-safety engineering**
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* (3.7) or through the quantification of risk for a group of fire scenarios

[SOURCE: ISO/~~IEC~~ 13943:2008, 4.126]



**3.7**
**fire scenario**
qualitative description of the course of a *fire* (3.3) with respect to time, identifying key events that characterise 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.

[SOURCE: ISO/~~IEC~~ 13943:2008, 4.129]



**3.8**
**intermediate-scale fire test**
fire test performed on a test specimen of medium dimensions

Note 1 to entry: A fire test performed on a test specimen for which the maximum dimension is between 1 m and 3 m is usually called an intermediate-scale fire test.

[SOURCE: ISO/~~IEC~~ 13943:2008, 4.200]

**3.9**
**large-scale fire test**
fire test that cannot be carried out in a typical laboratory chamber, performed on a test specimen of large dimensions

Note 1 to entry: A fire test performed on a test specimen of which the maximum dimension is greater than 3 m is usually called a large-scale fire test.

[SOURCE: ISO/~~IEC~~ 13943:2008, 4.205]

**3.10**
**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, 3.2.22]

**3.11**
**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

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

**3.12**
**reaction to fire**
response of a test specimen when it is exposed to *fire* (3.2) 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~~/IEC~~ 13943:2008, 4.272]



**3.13**
**real-scale fire test**
fire test that simulates a given application, taking into account the real scale, the real way the item is installed and used, and the environment



Note 1 to entry: Such a fire test normally assumes that the products are used in accordance with the conditions laid down by the specifier and/or in accordance with normal practice.

[SOURCE: ISO~~/IEC~~ 13943:2008, 4.273]

**3.14**
**short-circuit**
unintended connection of two nodes of an electrical circuit

Note 1 to entry: Current flow can occur, which could cause circuit damage, overheating, fire or explosion.

**3.15**
**small-scale fire test**
fire test performed on a test specimen of small dimensions

Note 1 to entry: A fire test performed on a test specimen of which the maximum dimension is less than 1 m is usually called a small-scale fire test.

[SOURCE: ISO~~/IEC~~ 13943:2008, 4.292]

## 4 Fire hazards associated with electrotechnical products

The transmission, distribution, storage and utilization of electrical energy can have the potential to contribute to fire hazard.

With electrotechnical products, the most frequent causes of ignition are overheating and arcing. The likelihood of ignition will depend on the product and system design, the use of safety devices and systems, and the type of materials used.

Electrotechnical products, when operating, generate heat. In some cases, arcing and sparking are normal phenomena. ~~These potential risks~~ They should not lead to hazardous conditions provided that they have been taken into account initially at the design stage, and subsequently during installation, use and maintenance.

Although it is a commonly held belief that most electrical fires are caused by a short-circuit, there are many other possible causes of ignition. These can include improper installation, improper ~~utilization~~ usage, and inadequate maintenance. Examples are: operation under overload for temporary or extended periods; operation under conditions not provided for by the manufacturer or contractor; inadequate heat dissipation; faulty ventilation. Table 1 lists common ignition phenomena encountered in electrotechnical products.

In Table 1, unless otherwise indicated, the sources of ignition are considered to be internal to the electrotechnical product. ~~It includes~~ The table lists the most frequently encountered cases. ~~The sequence indicated is not related to the magnitude or frequency of occurrence.~~

Fires involving electrotechnical products can also be initiated from external non-electrical sources. Hazardous conditions, which do not arise from the use of the electrotechnical product itself, can and often do involve that product. Considerations of this nature are dealt with in the overall hazard assessment, individual product safety standards, or, for example, by the provisions of IEC TS 62441 [21].

Examples of the power output of potential ignition sources are provided in Annex A.

When designing products, the prevention of ignition in normal and abnormal operating conditions requires a higher priority compared to minimizing the eventual spread of flames.

After ignition has occurred, for whatever reason, the effects of the subsequent fire must be assessed. Factors to be taken into account include:

a) fire growth and flame spread;
b) heat release;
c) smoke generation (visibility);
d) production of toxic fire effluent;
e) production of potentially corrosive fire effluent;
f) the potential for explosion.

References to IEC guidance on items a) to e) can be found in Annex B. The safety of electrotechnical equipment used in explosive atmospheres is discussed in IEC 60079-0.

## 5 Fundamentals of fire hazard testing

### 5.1 Objectives

The objectives of fire hazard testing of electrotechnical products are to determine which fire properties of the product contribute to the potential effects of fire and/or how the product or part of the product contributes to the initiation, growth and effect of fire, and then to use this knowledge to reduce the risks of fire in electrotechnical products.

## 5.2 Fire hazard and fire risk

### 5.2.1 Fire hazard

A fire hazard is a physical object or condition with a potential for an undesirable consequence from fire (see 3.4). Fire hazards therefore encompass potential fuels and ignition sources. Ignition of an electrotechnical product can be caused by an electrically energised component part~~, and the conditions which can cause ignition are of three types: an abnormal temperature rise, a short-circuit, or accidental arcs or sparks. Table 1 lists possible origins of such phenomena and also lists the possible consequential effects.~~ Ignition occurs as a result of an increase in temperature (see IEC 60695-1-20 [20]) that may have a chemical, mechanical or electrical origin.

Common ignition phenomena encountered in electrotechnical products are described in detail in Table 1, which also lists possible consequential effects.

Fires involving electrotechnical products can also be initiated from external non-electrical sources, and an overall ~~risk~~ fire hazard assessment should include this possibility.