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INTERNATIONAL STANDARD

NORME INTERNATIONALE

BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

Fire hazard testing –
Part 9-1: Surface spread of flame – General guidance

Essais relatifs aux risques du feu –
Partie 9-1: Propagation des flammes en surface – Lignes directrices générales

IEC 60695-9-1:2013

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FIRE HAZARD TESTING –

Part 9-1: Surface spread of flame –
General guidance

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.
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International Standard IEC 60695-9-1 has been prepared by IEC technical committee 89: Fire hazard testing.

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

FDIS	Report on voting
89/1159/FDIS	89/1164/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.

This third edition cancels and replaces the second edition of IEC 60695-9-1 published in 2005, and constitutes a technical revision.

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

a) an expanded scope;

b) updated references;

c) updated terms and definitions.

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

This international standard is to be used in conjunction with IEC 60695-9-2.

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 60695-9 consists of the following parts:

– Part 9-1:Surface spread of flame – General guidance

– Part 9-2: Surface spread of flame – Summary of test methods

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

INTRODUCTION

Fires are responsible for creating hazards to life and property as a result of the generation of heat (thermal hazard), and also toxic effluent, corrosive effluent and smoke (non-thermal hazard). Fire hazard increases with the burning area leading in some cases to flashover and a fully developed fire. This is a typical fire scenario in buildings.

The surface spread of flame beyond the area of ignition occurs as a result of the creation of a pyrolysis front on the surface of the material, ahead of the flame front, arising from the heating by the flame and external heat sources. The pyrolysis front is the boundary between pyrolysed material and unpyrolysed material on the surface of the material. Combustible vapours are generated within the region of pyrolysed material, which mix with air and ignite, creating the flame front.

The surface spread of flame rate is the distance travelled by the flame front divided by the time required to travel that distance. The surface spread of flame rate depends on the heat supplied externally and/or by the flame of the burning material ahead of the burning zone and on the ease of ignition. The ease of ignition is a function of the minimum ignition temperature, thickness, density, specific heat, and thermal conductivity of the material. The heat supplied by the flame depends on the heat release rate, specimen orientation, air flow rate and air flow direction relative to the surface spread of flame direction. In general, materials show one of the following types of surface spread of flame behaviour:

a) non-propagation: there is no flame propagation beyond the area of ignition;

b) decelerating propagation: flame propagation stops before reaching the end of the surface of the material; and

c) propagation: flame propagates beyond the area of ignition and eventually affects the entire surface of the material.

Properties of the materials that are used to describe the surface spread of flame behaviour are associated with surface preheating and pyrolysis, generation of vapours, mixing of the vapours with air, ignition, combustion of the mixture and generation of heat and combustion products. Flame retardants and surface treatments are used to modify the surface spread of flame behaviour. Factors that need to be considered for the assessment of the surface spread of flame behaviour of materials are:

1) the fire scenario (including such parameters as surface orientation, ventilation and the nature of the ignition source);

2) measurement techniques (see 5.5); and

3) the use and interpretation of results obtained (see 6).

FIRE HAZARD TESTING –

Part 9-1: Surface spread of flame – General guidance

1 Scope

This part of IEC 60695provides guidance for the assessment of surface spread of flame for electrotechnical products and the materials from which they are formed. It provides:

- an explanation of the principles of flame spread for both liquids and solids,
- guidance for the selection of test methods,
- guidance on the use and interpretation of test results, and
- informative references

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 60695-4, *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 their inclusion in standards*

ISO 13943:2008, *Fire safety – Vocabulary*

ISO 2592, *Determination of flash and fire points – Cleveland open cup method*

3 Terms and definitions

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

3.1
combustion
exothermic reaction of a substance with an oxidizing agent

Note 1 to entry: Combustion generally emits fire effluent accompanied by **flames** (3.11) and/or glowing.

[SOURCE: ISO 13943:2008, 4.46]

3.2
damaged area
total of those surface areas that have been affected permanently by **fire** (3.6) under specified conditions

Note 1 to entry: Users of this term should specify the types of damage to be considered. This can include, for example, loss of material, deformation, softening, melting behaviour, char formation, **combustion** (3.1), **pyrolysis** (3.25) or chemical attack.

Note 2 to entry: The typical units are square metres (m^2).

[SOURCE: ISO 13943:2008, 4.59]

3.3
damaged length
maximum extent in a specified direction of the **damaged area** (3.2)

[SOURCE: ISO 13943:2008, 4.60]

3.4
extent of combustion
⟨electrotechnical⟩ maximum length of a test specimen that has been destroyed by **combustion** (3.1) or **pyrolysis** (3.25), under specified test conditions, excluding any region damaged only by deformation

[SOURCE: ISO 13943:2008, 4.91]

3.5
fire
⟨general⟩ process of **combustion** (3.1) characterized by the emission of heat and fire effluent and usually accompanied by smoke, **flame** (3.11), 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** (3.6) and **fire** (3.7), 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]

3.6
fire
⟨controlled⟩ self-supporting **combustion** (3.1) 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]

3.7
fire
⟨uncontrolled⟩ self-supporting **combustion** (3.1) that has not been deliberately arranged to provide useful effects and is not limited in its extent in time and space

[SOURCE: ISO 13943:2008, 4.98]

3.8
fire hazard
physical object or condition with a potential for an undesirable consequence from **fire** (3.7)

[SOURCE: ISO 13943:2008, 4.112]

3.9
fire point
minimum temperature at which a material ignites and continues to burn for a specified time after a standardized small **flame** (3.11) has been applied to its surface under specified conditions

Note 1 to entry: In some countries, the term “fire point” has an additional meaning: a location where fire-fighting equipment is sited, which may also comprise a fire-alarm call point and fire instruction notices.

Note 2 to entry: The typical units are degrees Celsius (°C).

[SOURCE: ISO 13943:2008, 4.119]

3.10
fire scenario
qualitative description of the course of a **fire** (3.7) 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** (3.21) and fire growth processes, the **fully developed fire** (3.18) stage, the fire decay stage, and the environment and systems that impact on the course of the fire.

[SOURCE: ISO 13943:2008, 4.129]

3.11
flame, noun
zone in which there is rapid, self-sustaining, sub-sonic propagation of **combustion** (3.1) in a gaseous medium, usually with emission of light

[SOURCE: ISO 13943:2008, 4.133, modified – added "zone in which there is".]

3.12
flame front
boundary of flaming **combustion** (3.1) at the surface of a material or propagating through a gaseous mixture

[SOURCE: ISO 13943:2008, 4.136]

3.13
flame retardant, noun
substance added, or a treatment applied, to a material in order to suppress or delay the appearance of a **flame** (3.11) and/or reduce the **flame-spread rate** (3.15)

Note 1 to entry: The use of (a) flame retardant(s) does not necessarily suppress **fire** (3.5) or terminate **combustion** (3.1).

[SOURCE: ISO 13943:2008, 4.139]

3.14
flame spread
propagation of a **flame front** (3.12)

[SOURCE: ISO 13943:2008, 4.142]

3.15
flame-spread rate
surface spread of flame rate
DEPRECATED: burning rate
DEPRECATED: rate of burning
distance travelled by a **flame front** (3.12) during its propagation, divided by the time of travel, under specified conditions

[SOURCE: ISO 13943:2008, 4.143]

3.16
flashover
⟨stage of fire⟩ transition to a state of total surface involvement in a **fire** (3.7) of combustible materials within an enclosure

[SOURCE: ISO 13943:2008, 4.156]

3.17
flash point
minimum temperature to which it is necessary to heat a material or a product for the vapours emitted to ignite momentarily in the presence of **flame** (3.11) under specified conditions

[SOURCE: ISO 13943:2008, 4.154]

3.18
fully developed fire
state of total involvement of combustible materials in a **fire** (3.5)

[SOURCE: ISO 13943:2008, 4.164]

3.19
heat flux
amount of thermal energy emitted, transmitted or received per unit area and per unit time

Note 1 to entry: The typical units are watts per square metre ($W \cdot m^{-2}$)..

[SOURCE: ISO 13943:2008, 4.173]

3.20
heat release rate
DEPRECATED: burning rate
DEPRECATED: rate of burning
rate of thermal energy production generated by **combustion** (3.1)

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

[SOURCE: ISO 13943:2008, 4.177]

3.21
ignition
DEPRECATED: sustained ignition
⟨general⟩ initiation of **combustion** (3.1)

[SOURCE: ISO 13943:2008, 4.187]

3.22
ignition
DEPRECATED: sustained ignition
⟨flaming combustion⟩ initiation of sustained **flame** (3.11)

[SOURCE: ISO 13943:2008, 4.188]

3.23
ignition source
source of energy that initiates **combustion** (3.1)

[SOURCE: ISO 13943:2008, 4.189]

3.24
minimum ignition temperature
ignition point
minimum temperature at which sustained **combustion** (3.1) can be initiated under specified test conditions

Note 1 to entry: The minimum ignition temperature implies the application of a thermal stress for an infinite length of time.

Note 2 to entry: The typical units are degrees Celsius (°C).

[SOURCE: ISO 13943:2008, 4.231]

3.25
pyrolysis
chemical decomposition of a substance by the action of heat

Note 1 to entry: Pyrolysis is often used to refer to a stage of **fire** (3.5) before flaming **combustion** (3.1) has begun.

Note 2 to entry: In fire science, no assumption is made about the presence or absence of oxygen.

[SOURCE: ISO 13943:2008, 4.266]

3.26
pyrolysis front
boundary between the region of **pyrolysis** (3.25) and the region of unaffected material at the surface of the material

[SOURCE: ISO 13943:2008, 4.267]

3.27
surface spread of flame
flame spread (3.14) away from the source of **ignition** (3.22) across the surface of a liquid or a solid

[SOURCE: ISO 13943:2008, 4.317]

3.28
thermal inertia
product of thermal conductivity, density and specific heat capacity

EXAMPLES The thermal inertia of steel is $2{,}3 \times 10^8$ $J^2 \cdot s^{-1} \cdot m^{-4} \cdot K^{-2}$. The thermal inertia of polystyrene foam is $1{,}4 \times 10^3$ $J^2 \cdot s^{-1} \cdot m^{-4} \cdot K^{-2}$.