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TECHNICAL SPECIFICATION

Fire hazard testing –
Part 5-2: Corrosion damage effects of fire effluent – Summary and relevance of test methods

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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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IEC 60695-5-2, which is a technical specification, has been prepared by IEC technical committee 89: Fire hazard testing.

This third edition cancels and replaces the second edition published in 2002.

The main changes with respect to the previous edition are listed below:

– References to IEC TS 60695-5-3 (withdrawn in 2014) have been removed.
– ISO/TR 9122-1 has been revised by ISO 19706.
– References to ISO 11907-2 and ISO 11907-3 have been removed.
– Terms and definitions have been updated.
– Text in 5.4 has been updated.
– Text in 5.5.8 (5.7.8 in Ed. 2) has been updated.
– Text in Clause 6 (7 in Ed. 2) has been updated.

– Bibliographic references have been updated.

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

The text of this technical specification is based on the following documents:

Draft	Report on voting
89/1473/DTS	89/1506/RVDTS

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 Technical Specification 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/standardsdev/publications.

In this technical specification, the following print types are used:

Arial bold: terms referred to in Clause 3

This technical specification is to be read in conjunction with IEC 60695-5-1.

A list of all parts in the IEC 60695 series, published under the general title *Fire hazard testing*, 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,
- replaced by a revised edition, or
- amended.

INTRODUCTION

In the design of an 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 equipment design, as well as the choice of materials, is to reduce the risk of fire to a tolerable level even in the event of reasonably foreseeable (mis)use, malfunction or failure. IEC 60695-1-10 [1][1], IEC 60695-1-11 [2], and IEC 60695-1-12 [3] provide guidance on how this is to be accomplished.

Fires involving electrotechnical products can also 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 is to save lives and property by reducing the number of fires or reducing the consequences of the fire. This can be accomplished by:

- 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.
- trying to minimise flame spread beyond the product's enclosure and to minimise the harmful effects of **fire effluent**s including heat, **smoke**, and toxic or corrosive combustion products.

All **fire effluent** is corrosive to some degree and the level of potential to corrode depends on the nature of the fire, the combination of combustible materials involved in the fire, the nature of the substrate under attack, and the temperature and relative humidity of the environment in which the corrosion is taking place. There is no evidence that **fire effluent** from electrotechnical products offers greater risk of **corrosion damage** than the **fire effluent** from other products such as furnishings, building materials, etc.

The performance of electrical and electronic components can be adversely affected by **corrosion damage** when subjected to **fire effluent**. A wide variety of combinations of small quantities of effluent gases, **smoke** particles, moisture and temperature may provide conditions for electrical component or system failures from breakage, overheating or shorting.

Evaluation of potential **corrosion damage** is particularly important for high value and safety-related electrotechnical products and installations.

Technical committees responsible for the products will choose the test(s) and specify the level of severity.

The study of **corrosion damage** requires an interdisciplinary approach involving chemistry, electricity, physics, mechanical engineering, metallurgy and electrochemistry. In the preparation of this part of IEC 60695, all of the above have been considered.

IEC 60695-5-1 defines the scope of the guidance and indicates the field of application.

IEC 60695-5-2 provides a summary of test methods including relevance and usefulness.

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1 Numbers in square brackets refer to the bibliography.

FIRE HAZARD TESTING –

Part 5-2: Corrosion damage effects of fire effluent – Summary and relevance of test methods

1 Scope

This part of IEC 60695, which is a technical specification, gives a summary of the test methods that are used in the assessment of the corrosivity of **fire effluent**. It presents a brief summary of test methods in common use, either as international standards or national or industry standards. It includes special observations on their relevance, for electrotechnical products and their materials, to real **fire scenario**s and gives recommendations on their use.

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 publication will not apply unless specifically referred to or included in the relevant publications.

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

IEC 60695-5-1, *Fire hazard testing – Part 5-1: Corrosion damage effects of fire effluent - General guidance*

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

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

ISO 13943:2017*, Fire safety – Vocabulary*

ISO 19706:2011*, 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 13943:2017 (some of which are reproduced below), apply.

3.1
corrosion damage
physical and/or chemical damage or impaired function caused by chemical action

[SOURCE: ISO 13943:2017, 3.69]

3.2
corrosion target
sensor used to determine the degree of **corrosion damage** (3.1), under specified test conditions

Note 1 to entry: This sensor may be a product, a component. It may also be a reference material or object used to simulate the behaviour of a product or a component.

[SOURCE: ISO 13943:2017, 3.70]

3.3
fire effluent
all gases and aerosols, including suspended particles created by combustion or **pyrolysis** (3.6) and emitted to the environment

[SOURCE: ISO 13943:2017, 3.123]

3.4
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: See **fire scenario cluster** (ISO 13943:2017, 3.154) and **representative fire scenario** (ISO 13943:2017, 3.153).

Note 2 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 will impact on the course of the fire.

Note 3 to entry: Unlike deterministic fire analysis, where fire scenarios are individually selected and used as design fire scenarios, in fire risk assessment, fire scenarios are used as representative fire scenarios within fire scenario clusters.

[SOURCE: ISO 13943:2017, 3.152]

3.5
physical fire model
laboratory process, including the apparatus, the environment and the fire test procedure intended to represent a certain phase of a fire

[SOURCE: ISO 13943:2017, 3.298]

3.6
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 before flaming combustion has begun.

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

[SOURCE: ISO 13943:2017, 3.316]

3.7
smoke
visible part of a **fire effluent** (3.3)

[SOURCE: ISO 13943:2017, 3.347]

4 Classification of test methods

4.1 General

Test methods can be classified according to three criteria:

a) the nature of the test specimen which is burned;

b) the **physical fire model** used in the test;

c) the nature of the measurement of corrosivity.

4.2 Test specimen

4.2.1 Product testing

The test specimen is a manufactured product or a representative portion of a product. Examples include: a printed circuit board, a switchboard, a computer or a cable.

4.2.2 Material or composite sample testing

The test specimen is a basic material (solid or liquid), or composite of materials.

4.3 The physical fire model

Test methods use a wide variety of heat sources and geometries. The amount, the rate of production and the corrosive nature of **fire effluent** released from a given material or product is not an inherent property of that material or product, but is critically dependent on the conditions under which that material or product is burnt. In a **fire scenario** or a fire test, the chemical nature of the fuel, the decomposition temperature and the amount of ventilation are the main variables which affect the composition of **fire effluent**.

It is critical to show that the test conditions defined in a standardized test method are relevant to, and replicate, the desired stage of a real fire. ISO has published a general classification of fire stages in ISO 19706, shown in Table 1. The important factors affecting effluent production are oxygen concentration and irradiance/temperature.

4.4 The nature of the corrosivity measurement

4.4.1 Product as target

In these cases the **corrosion target** is a manufactured product or a representative portion of a product. Examples include: printed wiring boards, switchboards, washing machines and computers.

The **corrosion damage** effects of **fire effluent** on the product can be assessed by degradation of function as determined by inspection or measurement.

4.4.2 Simulated product as target

When a simulated product is used as the target, the **corrosion target** is typically a reference circuit, a thin sheet of metal or a metal mirror. The **corrosion damage** effects of **fire effluent** on the target can be assessed by changes in appearance, mass or measurements of mechanical, physical or electrical characteristics.