

Fire hazard testing —

Part 7-3: Toxicity of fire effluent — Use and interpretation of test results

ICS 29.020; 13.220

National foreword

This Draft for Development reproduces verbatim IEC TS 60695-7-3:2004. It supersedes PD IEC TR 60695-7-3:1998 which is withdrawn.

This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature because the subject matter is an area which is rapidly developing. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

Comments arising from the use of this Draft for Development are requested so that UK experience can be reported to the international organization responsible for the Technical Specification. A review of this publication will be initiated not later than 3 years after its publication by the international organization so that a decision can be taken on its status at the end of its 3-year life. Notification of the start of the review period will be made in an announcement in the appropriate issue of *Update Standards*.

According to the replies received by the end of the review period, the responsible BSI Committee will decide whether to support the conversion into an international standard, to extend the life of the Technical Specification for another 3 years or to withdraw it. Comments should be sent in writing to the Secretary of BSI Technical Committee GEL/89, Fire Hazard Testing, at 389 Chiswick High Road, London W4 4AL, giving the document reference and clause number and proposing, where possible, an appropriate revision of the text.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international publications referred to in this document may be found in the BSI Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

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Partie 7-3:

Toxicité des effluents du feu –

Utilisation et interprétation des résultats d'essai

Fire hazard testing –

Part 7-3:

Toxicity of fire effluent –

Use and interpretation of test results



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIRE HAZARD TESTING –

Part 7-3: Toxicity of fire effluent – Use and interpretation of test results

FOREWORD

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The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 60695-7-3, which is a technical specification, has been prepared by IEC technical committee 89: Fire hazard testing.

This second edition of IEC 60695-7-3 cancels and replaces the first edition published in 1998. It constitutes a technical revision.

The structure of this technical specification remains essentially the same but has been usefully expanded in all areas to further clarify the alignment with ISO/TC 92 *Fire Safety* and in particular with ISO 13344 and ISO/TS 13571.

The main topics have been expanded upon to bring them into alignment with the current philosophy for the use and interpretation of test results.

- Formulae are given for the calculation of the fraction of the incapacitating dose for each of the asphyxiants, carbon monoxide and hydrogen cyanide.
- Volume fractions that are expected to cause incapacitation (F values) are given for some of the more important irritants.
- Equations used to predict death are given.
- The hyperventilatory effect of carbon dioxide is discussed.

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

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

Enquiry draft	Report on voting
89/592/DTS	89/629/RVC

Full information on the voting for the approval of this technical specification 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 technical specification is to be used in conjunction with IEC 60695-7-1 and IEC 60695-7-2.

IEC 60695-7, under the general title *Fire hazard testing – Part 7: Toxicity of fire effluent*, consists of the following parts:

- Part 7-1: Toxicity of fire effluent – General
- Part 7-2: Toxicity of fire effluent – Summary and relevance of test methods
- Part 7-3: Toxicity of fire effluent – Use and interpretation of test results
- Part 7-50: Toxicity of fire effluent – Estimation of toxic potency – Apparatus and test method
- Part 7-51: Toxicity of fire effluent – Estimation of toxic potency – Calculation and interpretation of test results

The committee has decided that the contents of this publication will remain unchanged until 2009. At this date, the publication will be

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

INTRODUCTION

Electrotechnical products sometimes become involved in fires. However, except for certain specific cases (e.g. power generating stations, mass transit tunnels, computer suites), electrotechnical products are not normally present in sufficient quantities to form the major source of toxic hazard. For example, in domestic dwellings and places of public assembly, electrotechnical products are usually a very minor source of fire effluent compared with, for example, furnishings.

It should be noted that the IEC 60695-7 series is subject to the ongoing evolution of fire safety philosophy within ISO/TC 92.

The guidance in this technical specification is consistent with the principles of fire safety developed by ISO TC 92 SC 3 on toxic hazards in fire, as described in ISO/TR 9122-1 to 9122-6. General guidance for the assessment of the fire hazard of electrotechnical products is given in IEC 60695-1-1. Guidance on the estimation of escape times from fires is given in ISO/TS 13571. The determination of the lethal toxic potency of fire effluents is described in ISO 13344.

The following is a summary of the views expressed in ISO/TR 9122-1 (*Toxicity testing of fire effluents – Part 1: General*).

"Small-scale toxic potency tests as we know them today are inappropriate for regulatory purposes. They cannot provide rank orderings of materials with respect to their propensity to produce toxic atmospheres in fires. All currently available tests are limited because of their inability to replicate the dynamics of fire growth which determine the time/concentration profiles of the effluent in full-scale fires, and the response of electrotechnical products, not just materials. This is a crucial limitation because the toxic effects of combustion effluent are now known to depend much more on the rates and conditions of combustion than on the chemical constitution of the burning materials."

Because of these limitations IEC TC 89 has developed IEC 60695-7-50. This is a practical small-scale test for toxic potency which, by virtue of its ability to model defined stages of a fire, will yield toxic potency data suitable for use in a full hazard assessment. The test method follows the guidance of ISO TC 92 SC 3 in terms of the fire models used, and in methods of measurement of effluent. IEC 60695-7-51 covers the calculation and interpretation of test results, again following the guidance of ISO TC 92 SC 3.

The evidence from fires and fire casualties, when taken with data from experimental fire and combustion toxicity studies, suggests that chemical species with unusually high toxicity are not important (see Clause 7). Carbon monoxide is by far the most significant agent contributing to toxic hazard. Other agents of major significance are hydrogen cyanide, carbon dioxide and irritants. There are also other important, non-toxic, threats to life. These are the effects of heat and radiant energy, the effects of depletion of oxygen, and the effects of smoke obscuration, which are all discussed in ISO/TS 13571. General guidance on the effects of smoke obscuration is given in IEC 60695-6-1.

ISO/TR 9122-1 recognizes that effective mitigation of toxic hazard is best accomplished by tests and regulations leading to improved resistance to ignition and to reduced rates of fire growth, thus limiting the level of exposure to fire effluent.

FIRE HAZARD TESTING –

Part 7-3: Toxicity of fire effluent – Use and interpretation of test results

1 Scope

This technical specification concerns laboratory tests used to measure the toxic components of the fire effluent from either electrotechnical products or materials used in electrotechnical products. It provides guidance on the use and interpretation of results from such tests. It discusses currently available approaches to toxic hazard assessment consistent with the approach of ISO TC 92 SC 3, as set out in ISO/TR 9122-1 to 9122-6, ISO 13344 and ISO/TS 13571. It also provides guidance on the use of toxic potency data in hazard assessment and on principles which underlie the use of combustibility and toxicological information in hazard assessment.

The methods described are applicable to data concerning both the incapacitating effects and the lethal effects of fire effluents.

One of the responsibilities of a technical committee is, wherever applicable, to make use of basic safety publications in the preparation of its publications (see IEC Guide 104).

2 Normative references

The following referenced documents are indispensable for the application 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 60695-1-1:1999, *Fire hazard testing – Part 1-1: Guidance for assessing the fire hazard of electrotechnical products – General guidelines*

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

ISO/TR 9122 (all parts), *Toxicity testing of fire effluents*

ISO 13344:1996, *Determination of the lethal toxic potency of fire effluents*

ISO/TS 13571:2002, *Life-threatening components of fire – Guidelines for the estimation of time available for escape using fire data*

3 Terms and definitions

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

3.1

acute toxicity

ability of a substance to produce rapidly occurring adverse effects upon a living organism

3.2

asphyxiant

a toxicant causing loss of consciousness and ultimately death resulting from hypoxic effects, particularly on the central nervous and/or cardiovascular systems

3.3

burn, intransitive verb

to undergo combustion

[ISO/IEC 13943, definition 10]

3.4

combustible, adjective

capable of being combusted

[ISO/IEC 13943, definition 21]

3.5

combustible, noun

item capable of combustion

[ISO/IEC 13943, definition 22]

3.6

combustion

exothermic reaction of a substance with an oxidizer

NOTE Combustion generally emits effluent accompanied by flames and/or visible light.

[ISO/IEC 13943, definition 23]

3.7

concentration

amount of substance per unit volume

3.8

effective concentration, EC_{50}

concentration or volume fraction of a toxicant, or mixture of toxicants that, when inhaled for a specified period of time, causes a specific observed effect in 50 % of a population all of which are the same species and all exposed under the same experimental conditions

NOTE The observed effect is typically either a behavioural response indicative of incapacitation or death. The effective concentration for a lethal exposure is termed " LC_{50} ", the lethal concentration.

3.9

effective exposure dose 50, ECt_{50}

exposure dose of a toxicant that, when inhaled, causes a specific observed effect in 50 % of a population all of which are the same species and all exposed under the same experimental conditions

NOTE The observed effect is typically either a behavioural response indicative of incapacitation or death. The ECt_{50} for a lethal exposure is termed " LCt_{50} ", the lethal exposure dose 50.

3.10

exposure dose

a measure of a gaseous toxicant or of a fire effluent which is available for inhalation, i.e. the integrated area under either the concentration-time curve or the volume fraction-time curve

3.11**fire**

(controlled) self-supporting combustion which has been deliberately arranged to provide useful effects and which is controlled in its extent in time and space

NOTE In the English language the word "fire" can have two meanings which translate into two different words in both French and German.

[ISO/IEC 13943, definition 40]

3.12**fire**

(uncontrolled) self-supporting combustion which spreads uncontrolled in time and space

[ISO/IEC 13943, definition 41]

3.13**fire effluent**

totality of gases and/or aerosols (including suspended particles) created by combustion or pyrolysis

[ISO/IEC 13943, definition 45]

3.14**fire hazard**

potential for injury and/or damage from fire

[ISO/IEC 13943, definition 48]

3.15**fire model**

procedure or process intended to represent, predict or reproduce one or more phases of a fire, or the transition between phases

[ISO/IEC 13943, definition 51]

3.16**fire risk**

product of

- probability of occurrence of a fire to be expected in a given technical operation or state, and
- consequence or extent of damage to be expected on the occurrence of a fire

[ISO/IEC 13943, definition 57]

3.17**fire scenario**

detailed description of conditions, including environmental, of one or more stages from before ignition to after completion of combustion in an actual fire at a specific location or in a real-scale simulation

[ISO/IEC 13943, definition 58]

3.18**flame spread**

propagation of a fire front

[ISO/IEC 13943, definition 68]

3.19**flash-over**

transition to a state of total surface involvement in a fire of combustible materials within an enclosure

[ISO/IEC 13943, definition 77]