

Fire hazard testing —

Part 8-2: Heat release — Summary and relevance of test methods

ICS 13.220.40; 29.020

National foreword

This Published Document is the UK implementation of IEC/TR 60695-8-2:2008. It supersedes BS IEC/TS 60695-8-2:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/89, Fire hazard testing.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 March 2008

© BSI 2008

ISBN 978 0 580 56464 2

Amendments/corrigenda issued since publication

Date	Comments



TECHNICAL REPORT

**Fire hazard testing –
Part 8-2: Heat release – Summary and relevance of test methods**

CONTENTS

INTRODUCTION	3
1 Scope	4
2 Normative references	4
3 Terms and definitions	5
4 Summary of test methods	7
4.1 Measurement of complete combustion	8
4.1.1 The bomb calorimeter	8
4.2 Measurements of incomplete combustion	9
4.2.1 Cone calorimeter	9
4.2.2 The Ohio State University calorimeter	10
4.2.3 Vertical cable ladder tests	11
4.2.4 SBI test	13
4.2.5 Horizontal cable ladder test	15
4.2.6 Open calorimetry fire tests	17
Bibliography	18
Table 1 – Summary and comparison of vertical cable ladder tests	14

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 equipment design as well as the choice of materials is to reduce to acceptable levels the potential risks of fire even in the event of foreseeable abnormal use, malfunction or failure. IEC 60695-1-10 [1]¹⁾, together with its companion, IEC 60695-1-11 [2], provide guidance on how this is to be accomplished.

The primary aims are as follows:

- 1) to prevent ignition caused by an electrically energized component part, and
- 2) in the event of ignition, to confine any resulting fire within the bounds of the enclosure of the electrotechnical product.

Secondary aims include the minimization of any flame spread beyond the product's enclosure and the minimization of 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 heat sources. Considerations of this nature are dealt with in the overall risk assessment.

Fires are responsible for creating hazards to life and property as a result of the generation of heat (thermal hazard), toxic and/or corrosive compounds and obscuration of vision due to smoke. Fire risk increases as the heat released increases, possibly leading to a flash-over fire.

One of the most important measurements in fire testing is the measurement of heat release and it is used as an important factor in the determination of fire hazard; it is also used as one of the parameters in fire safety engineering calculations.

The measurement and use of heat release data, together with other fire test data, can be used to reduce the likelihood of (or the effects of) fire, even in the event of foreseeable abnormal use, malfunction or failure of electrotechnical products.

When a material is heated by some external source, fire effluent can be generated and can form a mixture with air which can ignite and initiate a fire. The heat released in the process is carried away by the fire effluent-air mixture, radiatively lost or transferred back to the solid material, to generate further pyrolysis products, thus continuing the process.

Heat may also be transferred to other nearby products, which may burn, and then release additional heat and fire effluent.

The rate at which thermal energy is released in a fire is defined as the heat release rate. Heat release rate is important because of its influence on flame spread and on the initiation of secondary fires. Other characteristics are also important, such as ignitability, flame spread and other side effects of the fire (see the IEC 60695 series of standards).

1) Figures in square brackets refer to the bibliography.

FIRE HAZARD TESTING –**Part 8-2: Heat release –
Summary and relevance of test methods****1 Scope**

This part of IEC 60695 presents a summary of published test methods that are relevant to determine heat release for electrotechnical products. It represents the current state of the art of the test methods and, where available, includes special observations on their relevance and use. The list of test methods is not to be considered exhaustive, and test methods which were not developed by IEC/TC 89 are not to be considered as endorsed by IEC TC89 unless this is specifically stated.

Heat release data can be used as part of fire hazard assessment and in fire safety engineering, as discussed in IEC 60695-1-10 [1] and IEC 60695-1-11 [2].

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 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 60695-4:2005, *Fire hazard testing – Part 4: Terminology concerning fire tests for electrotechnical products*

IEC 60695-8-1:2001, *Fire hazard testing – Part 8-1: Heat release – General guidance*

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/IEC 13943:2000, *Fire safety – Vocabulary*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. Other terms and definitions are as given in IEC 60695-4 and ISO 13943.

3.1

combustion

exothermic reaction of a substance with an oxidizing agent

NOTE Combustion generally emits fire effluent accompanied by flames and/or glowing.

[ISO/IEC 13943, definition 23 modified]

3.2

combustion products

solid, liquid and gaseous material resulting from combustion

NOTE Combustion products may include fire effluent, ash, char, clinker and/or soot.

3.3

complete combustion

combustion in which all the combustion products are fully oxidized

NOTE 1 This means that when the oxidizing agent is oxygen, all carbon is converted to carbon dioxide and all hydrogen is converted to water.

NOTE 2 If elements other than carbon, hydrogen and oxygen are involved in the combustion process, then it may not be possible to uniquely define complete combustion.

3.4

controlled fire

fire which has been deliberately arranged to provide useful effects and which is controlled in its extent in time and space

3.5

effective heat of combustion

heat released from a burning test specimen in a given time interval divided by the mass lost from the test specimen in the same time period

NOTE 1 It is the same as the net heat of combustion if all the test specimen is converted to volatile combustion products and if all the combustion products are fully oxidized.

NOTE 2 The typical units are $\text{kJ}\cdot\text{g}^{-1}$.

3.6

fire

process of combustion characterized by the emission of heat and fire effluent accompanied by smoke, and/or flame, and/or glowing

3.7

fire effluent

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

[ISO/IEC 13943, definition 45]

3.8

fire hazard

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