
British Standard Guide to

Development and presentation of fire tests and their use in hazard assessment

Guide au développement et à la présentation des essais au feu et à l'utilisation
de ceux-ci dans l'évaluation des risques

Leitfaden für die Entwicklung und Darstellung von Brandversuchen und für
die Anwendung bei der Gefahrenewertung

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Foreword

This British Standard has been prepared under the direction of the Coordinating Committee on Fire Tests and has taken account of comment derived from DD 64, which it supersedes.

In 1974 BSI, following consultation with industry, commerce and Government bodies, constituted the Coordinating Committee on Fire Tests with the object of developing a general policy and philosophy for the development and use of fire tests. Resulting from work by that committee, BSI published DD 64 : 1979 'Guidelines for the development and presentation of fire tests and for their use in hazard assessment'. This was issued as a Draft for Development as the guidelines given in it represented a new approach to the development and presentation of fire tests and to their use in hazard assessment. The philosophy proposed had not then been subjected to much practical

application nor had it been considered internationally. DD 64 was therefore issued both to give guidance and as a basis for comment which would help in the preparation of this British Standard, to which it was intended to lead.

The guidance in this British Standard is generally in line with the approach to fire testing being developed in the International Organization for Standardization (ISO). It is however recognized that it may not be internationally acceptable in its entirety, at least in the short term, since in some respects it may not accord with the national practices of other countries. Conversely, it has to be recognized that agreement on an international standard may require an element of compromise on detail (although this should never be in conflict with the main principles given in this standard). Minor differences in terminology may therefore be found in dual numbered British Standards which are identical with international standards.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

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Section one. General

0. Introduction

0.1 Background to this standard. There are over 300 000 fires each year in the UK alone and the cost is high: about 1000 lives lost, many thousands of serious injuries and hundreds of millions of pounds worth of direct damage. A wide variety of materials, products, structures and systems is involved and in recent years much concern has been expressed, both in the UK and internationally, over the use of inappropriate and possibly misleading fire tests to assess the behaviour of such materials, etc. in fires. There has also been concern over the use of misleading fire terminology and over the misuse of fire tests, particularly small-scale tests, as indications of fire safety.

0.2 What this standard is intended to achieve. This British Standard gives guidance to those concerned with maintaining acceptable standards of safety from fire and those concerned in any way with fire hazards and fire tests. It is intended to help specification writers, regulatory bodies, designers and architects, manufacturers and fabricators, wholesalers and retailers, consumer advice services and educational bodies. It is also issued for the use of BSI committees and staff.

This standard is intended to help anyone who prepares a specification or code of practice involving a material or product that can ignite, burn or overheat to take due account of any fire hazard which may arise from the use of that material or product.

It is also intended to help anyone purchasing, specifying or using such a material or product to understand the need to consider the possible fire hazard and the way in which fire tests may help in assessing that fire hazard. It will help them too to understand the need to consider any special precautions that may be required for its safe use in specific environments.

Finally it is hoped that the use of this standard will ensure in the interests of public safety that no one will misrepresent facts about fire tests or use their results in such a way as to give a false impression in relation to fire tests.

Fire tests in isolation can never guarantee fire safety.

0.3 What you will find in this standard. This standard is divided into three sections, its scope embracing both a practical and a theoretical approach to the subject. Section one is introductory. Section two explains the theory of fire behaviour, the hazard presented by fire and the relevance of fire tests to that hazard. Section three contains practical

guidance on the development of fire tests; the use of terms in fire tests; the presentation of fire test methods; the presentation of fire test results and how information about fire tests and their results should generally be conveyed. **It finishes with a summary of the guidance as a whole (see clause 11).**

1. Scope

This British Standard describes the theory of fire behaviour and fire hazard, the assessment of fire hazard and the need for fire tests. It provides guidance on the development of fire tests and on the use of related terminology.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

2. Definitions

For the purposes of this British Standard, the following definitions apply.

NOTE. The majority of the technical terms used in this standard do not have standardized definitions and one, 'hazard concept', is introduced in this standard.

2.1 fire. A process of combustion characterized by heat or smoke or flame or any combination of these*.

2.2 fire hazard. A physical situation with a potential for harm to life or limb, or damage to property, or both, from the effects of fire †.

2.3 fire risk. The probability that a damaging fire will occur as the result of the existence of a fire hazard †.

2.4 ignition risk. The probability that, if a source of heat is allowed into close proximity or contact with a flammable material, as the result of the existence of a fire hazard, ignition will result.

2.5 life risk (from fire). The probability that, if a fire occurs as the result of the existence of a fire hazard, an individual or individuals will suffer death or serious injury.

2.6 property risk (from fire). The probability that, if a fire occurs as the result of the existence of a fire hazard, serious damage to property will result.

2.7 fire test. A procedure designed to measure or assess the response of a material, product, structure or system to one or more aspects of fire.

2.8 hazard concept. A property, quality or function of a material, product, structure or system which is capable of affecting the contribution of that material, product, etc. to a fire hazard and is measurable by means of a fire test.

* Taken from BS 4422 : Part 1.

† Derived from definitions in 'Advisory Committee on Safety Hazards. Second Report. Health and Safety Commission. HMSO, 1979', which is obtainable from HMSO, 49 High Holborn, London WC1.

Section two. Theory

3. How fire behaves

3.1 General. Despite its apparently simple definition (see 2.1) fire is a complex phenomenon in which many simultaneous processes interact. Most fires start from a small source, usually in a context where a source of heat and a combustible material are brought together, such that decomposition of the material occurs producing flammable vapours which may be ignited. If the heat source is too small, or the mass of the material to be ignited is too large, or its ignition temperature is too high, only localized damage may occur without progression to a fire. Different combustible materials need different amounts of heat to be applied before ignition can occur. For continued combustion, the rate of heat loss needs to be less than the sum of the rate of heat given out by the extraneous heat source and the rate of heat generated by the combustion process.

3.2 Stages of fire. The progress of most fires (when there is no attempt at putting them out) can be divided into the following stages.

(a) *Initiation.* The process, as described in 3.1, in which fire is established.

(b) *Spread (or growth, or propagation).* The continued release of flammable vapours leading to combustion, this continues until there are no further supplies of accessible fuel or air to become involved.

(c) *A 'steady' period.* The stage at which the fire may be said to be 'fully developed' and all combustible materials are burning steadily.

(d) *Termination.* The final phase during which the fire is burning itself out.

In some circumstances, a fire may die out of its own accord without stage (c) being reached; in others, all four stages may be telescoped into a very short space of time, e.g. a person's clothing alight, or a flammable vapour/air mixture 'exploding'.

Though these stages are characteristic of a fire as a whole, different parts of a fire may exhibit different stages at the same time: some parts of the fuel or fuels may be reaching their termination phase, for example, while others are still growing. The fact that growth is taking place means that new parts of the fuel or fuels are continuously entering their initiation stage. Furthermore, at any point in the progress of a fire its course may be altered by random events such as the involvement of petrol in a car fire, the rupturing of a container of flammable liquid in a chemical plant fire or the breaking of a window in a room fire, any of which may have drastic effects on the fire's development.

3.3 Examining behaviour of materials in fire. The examination of the behaviour of materials, components, products, etc. in fire, which is vital in setting up safety measures, is exceedingly difficult in a complex environment. Since many features of the combustion process are not yet clearly understood, only some of them can be analysed, and then only in situations that are well defined and in which the number of factors involved is kept to a minimum. All but the most elaborate analytical experiments will therefore have to concern themselves with one of the stages of fire at a time.

3.4 Advice about fire behaviour. While someone properly versed in fire technology (a 'fire expert') can give advice in general terms about how, when and where fires are likely to start and to develop, decisions about how such general

principles should apply in a given situation should only be taken by people fully conversant with the technical details and likely usage or application of materials and components in that situation.

As an illustration of this, a fire expert will be able to point to the likely ignition sources that could start a fire in the combustible materials in a car (e.g. upholstery covering and padding, floor and head covering, wiring insulation and fuel). He can also advise on how a fire, once started, could spread, and on measures to prevent this. However, only someone familiar in detail with the construction of cars will be able to identify what materials have been used, how exactly they will behave and what the chances are of being able to use other materials with different properties in their place. Thus, joint consultation is needed to determine the likelihood of a fire starting, the chances of its developing and means of halting the fire's progress that are feasible in terms of suitability, economic viability, ready availability, etc. Similar considerations apply wherever a fire could start and develop.

4. Fire hazard and its assessment

4.1 Fire hazard (see 2.2). It is fundamental to the definition that, before a fire hazard can be said to exist, a physical situation be envisaged. A piece of insulated wire, a ceiling tile or a flammable liquid cannot in itself be considered as a fire hazard. A situation has to be envisaged, or specified, in which the article is placed or used in such a way that a potential for harm exists. It is inherent in such situations that some way exists in which a source of heat can arise; although many other factors may also determine whether a fire hazard exists, and if it does, at what level of severity.

4.2 Fire hazard assessment

4.2.1 General. If any possible potential for harm from the effects of fire can be envisaged in a given situation, the hazard should be assessed. It cannot be emphasized too strongly that attention to this has to be paid at an early stage in any proposal or design, since the reduction of fire hazard is likely to be much more difficult and costly once the design has taken shape.

The assessment process may have to be carried out many times, according to the different ways in which the material, product or design concerned can be involved in a physical situation with a potential for harm.

As in forecasting the behaviour of fire, referred to in 3.4, joint consultation should take place between a fire expert and specialists in the relevant materials, plant, equipment or building who are familiar with their characteristics under normal, everyday conditions. In this way, the general theory of fire can be applied to realistic hypothetical situations and decisions can be taken about the severity of fire hazards and the prospect of reducing them.

4.2.2 Interested personnel. Any study of the techniques of fire hazard assessment has to start from the standpoint of all persons with an interest in fire hazard, and there are so many people with so many different interests that it is difficult to put the subject into manageable form. However, it may be simplified by assuming (somewhat arbitrarily) that there are three main groups of interested people.

(a) Those dealing with a material or product that may either give rise to a fire or become the starting point of a fire through chance contact with a source of ignition (e.g. a floor covering; an electric blanket; a thermostat).