TECHNICAL REPORT

ISO/TR 5658-1

First edition
1997-12-15

Reaction to fire tests — Spread of flame —

Part 1:
Guidance on flame spread

Essais de réaction au feu — Propagation du feu —

Partie 1: Guide sur la propagation de la flamme

Reference number
ISO/TR 5658-1:1997(E)

Contents

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

Printed in Switzerland

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 5658-1, which is a Technical Report of type 3, was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Reaction to fire*.

ISO 5658 consists of the following parts, under the general title *Reaction to fire tests — Spread of flame*:

— *Part 1: Guidance on flame spread* (Technical Report)

— *Part 2: Lateral spread on building products in vertical configuration*

— *Part 3: Lateral ignition of and flame spread on building products in vertical configuration (LIFT) method* (Technical Report)

— *Part 4: Intermediate-scale spread of flame with vertically oriented specimens*

Annex A of this Technical Report is for information only.

Introduction

The rate and extent of flame spread are important properties to be characterized when evaluating the reaction-to-fire hazards of construction products. Historically, there have been many approaches taken to the measurement of flame spread and most of these have evolved with little fundamental justification. This Technical Report describes different modes of flame spread and proposes some theoretical principles to assist with the relevant application of the data obtained from flame spread tests.

Many flame spread tests measure the rate and extent of the flame front as the flame moves over the surface of large-area, flat products such as linings on walls, ceilings and floors. Usually the orientation of the test specimen is related to the end-use application (for example, exposed face upwards for floor-coverings). This requirement for end-use relevance is satisfied by ISO 5658-2 and ISO/TR 5658-3 when wall-linings are to be evaluated.

Flame spread over construction products is related to the fire scenario. ISO/TC 92/SC 1 have concentrated on development of tests to simulate flame spread in rooms and along corridors. Other important scenarios where flame spread data are required are facades (both front and behind), shafts, stairs and roofs; much of the theoretical guidance given in this Technical Report may be applied to these scenarios even though ISO test procedures may not yet be available.

Flame spread can also occur over non-planar products (e.g. pipes) and within assemblies (e.g. along joints or inside air-gaps). Whilst this Technical Report concentrates on the theory pertinent to flat products, some of the theory outlined may be applied to improve the understanding of these more complex situations (see clause 8, flame spread within assemblies).

Flame spread initiated by removal of flaming drops or debris is not treated in this Technical Report. Empirically derived tests for these secondary flame spread phenomena are available (see ref. [34]).

> NOTE — Flame spread can be reduced and sometimes eliminated due to melting and dripping; these effects are also not treated in this Technical Report.

Reaction to fire tests — Spread of flame —

Part 1:
Guidance on flame spread

1 Scope

This Technical Report provides guidance on flame spread tests for construction products. It describes the principles of flame spread and classifies different flame spread mechanisms.

The results of small-scale flame spread tests (e.g. ISO 5658-2 [31], ISO/TR 5658-3 [32] and ISO 9239-1 [35]) and large-scale tests (e.g. ISO 9705 [13]) may be used as components in a total hazard analysis of a specified fire scenario. The theoretical basis of these tests is explained so that relevant conclusions or derivations may be made from the test results.

2 Principles of flame spread

Flammability of room surfaces is a major concern of all building regulations. The primary room surfaces in question are any combustible linings used on the walls or ceilings, along with floor coverings. To understand the role of bench-scale tests in assessing this hazard, the dominant fire effects must be placed in context.

The ceiling can show a very rapid fire spread and a high contribution to hazard. Recent research suggests that the least combustible materials should be allocated to the ceiling in order to minimize fire hazard. There is not universal agreement on this point, however, and some studies conclude the opposite (see reference [25]). For almost any fire scenario, flame spread along the ceiling is wind-aided, that is, the air-flow and the flame spread are both in the same direction.

For common fire scenarios, flame spread on walls will be upward, that is wind-aided, in the vicinity of the fire source. In other parts of the walls, flame spread will be downward, that is opposed-flow, since entrained air is moving upwards, opposite to the direction of flame motion. Much of the wall can, however, be directly ignited by submersion into the layer of hot gases forming below the ceiling. This ignition does not involve a flame spread process at all, but it is directly accelerated by ceiling flammability.

Flame spread on floors is generally ignorable within a room since it is very limited until quite late in a fire. Flame spread on floors in corridors, however, can be of major concern. This flame spread is usually caused by a room fire impinging on the adjacent corridor and igniting the flooring. There will usually be some prevailing air flow direction within a corridor. Flame spread can then proceed either in the wind-aided direction, or as opposed flow. Commonly, flame spread in both directions can occur simultaneously on corridor flooring materials.