
Fire safety engineering — Performance of structures in fire

*Ingénierie de la sécurité incendie — Performance des structures en
situation d'incendie*



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 24679 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 4, *Fire safety engineering*.

Introduction

Fire is an extreme loading condition for structures, which can lead to significant effects on people, property and the environment. Part of the fire safety design of a built environment arises out of the need to provide design strategies that minimize the occurrence and spread of fire and its impact on life, property and the environment. Fire safety of structures is one important component of an overall fire safety design strategy. The role of fire safety of structures is to ensure that elements of a structure (separating and structural elements) within a built environment are capable of preventing or delaying fire spread and structural failure so that the fire safety objectives, such as safety of life (for occupants and firefighters), conservation of property, continuity of operations, preservation of heritage and protection of the environment, are not compromised.

Traditionally, most designs for the fire safety of structures have been based on prescriptive requirements set by building regulations, building codes and associated standards. In prescriptive regulation, this is also known as *fire resistance*. The evaluation of fire resistance of construction elements is mainly determined by fire tests that involve:

- a single fire represented by a standard time-temperature curve (such as that given in ISO 834-1); and
- isolated elements or assemblies with defined boundary conditions and sizes.

Standard fire tests apply to fires with an inexhaustible fuel supply, where no distinction is made between enclosure size and ventilation, and which do not take into account realistic structural loads, the redistribution of load or conditions of structural restraint. Such an assessment method is only able to provide a comparative rating of the construction products but cannot furnish all the information required to make a fire safety analysis of a given built environment (e.g. smoke leakage, other types of fire, treatment of a full structure).

With the recent advances in fire safety engineering and the opportunity for designers to take advantage of an engineering approach when evaluating the performance of structures in fire, it is becoming necessary to:

- refine the philosophy covered by the fire safety of structures, in the case of real fires, with respect to the whole structure;
- move beyond the sole consideration of individual elements and include the behaviour of the entire structural system;
- consider realistic load conditions; and
- include the cooling phase of the fire.

This Technical Specification provides a methodology for applying an engineering approach to the assessment of fire performance of structures in real fires. In such an approach, the solutions are based on principles of reason, judgement, science, engineering and practicability. A rational approach offers many benefits, including:

- the provisions for better and more reliable fire safety in the built environment;
- potential cost-effective fire safety measures and more options with regard to the choice of these measures; and
- better communication with other professionals involved in the design, construction process and approval process.

This Technical Specification is intended for use by fire safety practitioners who employ performance-based design methods. Examples of users include fire safety engineers and structural engineers as well as

authorities having jurisdiction, such as authority officials, fire service personnel and code developers. It is expected that users of this Technical Specification are appropriately qualified and competent in the fields of fire safety and structural engineering. It is particularly important that the users understand the limitations of any methodology used.

In addition to the standard clauses (Clauses 1, 2, 3 and Bibliography), this Technical Specification includes the following clauses:

- Clause 4 provides generic ways of describing design strategies for the fire safety of structures;
- Clause 5 presents the quantification of the performance of structures in fire, which includes guidance on the steps and engineering methods used to predict the thermal and mechanical responses of structural and separating elements exposed to fire and thereby evaluate the potential for fire spread and structural failure. Also included is a description of the factors that should be taken into consideration in the assessment and quantification process, namely fire spread paths and material properties at elevated temperatures;
- Clause 6 gives guidance on the use of the different quantification methods.

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Fire safety engineering — Performance of structures in fire

1 Scope

This Technical Specification provides a methodology for assessing the performance of structures in the built environment when exposed to a real fire.

This Technical Specification, which follows the principles outlined in ISO 23932, provides a performance-based methodology for engineers to assess the level of fire safety of new or existing structures.

NOTE The fire safety of structures is evaluated through an engineering approach based on the quantification of the behaviour of a structure for the purpose of meeting fire safety objectives and can cover the entire time history of a real fire (including the cooling phase), and its consequences related to fire safety objectives such as life safety, property protection and/or environmental protection.

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.

ISO 834-1:1999, *Fire-resistance tests — Elements of building construction — Part 1: General requirements*

ISO 13943, *Fire safety — Vocabulary*

ISO 23932, *Fire safety engineering — General principles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943, ISO 23932 and the following apply.

3.1

building element

integral part of a built environment

NOTE This includes floors, walls, beams, columns, doors, and penetrations, but does not include contents.

3.2

function

role and actions assigned to, or required or expected of, various parts of a structure to achieve a specified objective or task

3.3

load-bearing element

structural element

building element that is designed to carry loads besides its own weight