
Fire resistance — Tests for thermo-physical and mechanical properties of structural materials at elevated temperatures for fire engineering design

Résistance au feu — Essais des propriétés thermophysiques et mécaniques des matériaux aux températures élevées pour la conception de l'ingénierie contre l'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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire containment*.

This second edition cancels and replaces the first edition (ISO/TR 15655:2003), which has been technically revised.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Fire engineering has developed to the stage whereby detailed calculation procedures are now being carried out to establish the behaviour of structural elements and frames under the action of fire. These cover standard fire resistance furnace tests such as ISO 834 (all parts)^[1] as well as natural/real fires, in which performance based criteria covering stability, integrity and insulation may need to be determined.

As fire engineering is advanced through the development of design codes and standards, there is an increasing need to provide as inputs to the numerical calculations, the thermal and mechanical properties of construction materials at elevated temperatures. In addition, as part of the process in applying rules for the interpolation and extension of fire resistance test results, specific data on material properties is often required to conduct assessments on variations in construction other than those tested.

It is recognized that the elevated temperature properties of materials can be determined under a variety of conditions. Since fire is a relatively short transient process lasting from a few minutes to several hours, ideally, the properties determined should reflect the transient thermal and loading conditions as well as the duration of heating that may be experienced in practice. However, it is also recognized that some properties are relatively insensitive to the transient conditions and therefore, alternative steady state test methods may be appropriate. Some properties are sensitive to orientation effects, for example timber, and these should be considered with respect to how the tests are conducted.

In cases where materials undergo either a chemical or a physical reaction during the heating process, it might be impossible to determine an individual property. This document gives guidance in selecting a test method to determine an effective value representing a combination of properties. It is also recognized that a test specimen may be comprised of a small construction such as that used in the testing of masonry. This often involves building a mini assembly to form a pyramid in order to represent the true behaviour.

Apart from the traditional construction materials such as metals, concrete, masonry and wood, the use of plastics and fibre reinforcement is becoming more common. Therefore, these materials have also been included in this document to reflect possible future changes in design and advances in materials technology.

In the past, the behaviour of jointing systems in fire has received limited interest yet their behaviour is fundamental to the performance of composite elements and structural frames. This document also addresses jointing systems under individual materials, e.g. welds for steel, glues for timber. However, in many cases, the end use of an adhesive is not clear or it covers a range of applications. For this reason a separate category for adhesives is included.

The objectives of this document relate to test methods for determining the thermal and mechanical properties of construction materials for use in fire engineering design and has therefore been prepared to:

- Identify the existence of national or International Standards that provide suitable test methods for determining the thermal and mechanical properties at elevated temperatures of materials used in load bearing construction.
- Identify whether the test methods are based upon steady state or transient heating conditions and provide information on the limits of experimental conditions. For steady state tests, comment where possible, on the sensitivity of the parameter to the heating conditions and/or the suitability of the method being adopted for transient tests.
- Identify through the scientific literature, experimental techniques that have been used to determine a material property, which may be adopted by a standards body as a basis for further development into a full test standard. However, it should be noted that it is not the intention of this document to provide a definitive list of references but sources of information are given as an aid to initially reviewing some of the work conducted in a particular field of research.