INTERNATIONAL STANDARD

ISO 834-11

First edition
2014-03-01

Fire resistance tests — Elements of building construction —

Part 11: Specific requirements for the assessment of fire protection to structural steel elements

Essais de résistance au feu — Éléments de construction —

Partie 11: Exigences spécifiques d'évaluation de la protection au feu appliquées aux éléments des structures en acier

Reference number
ISO 834-11:2014(E)

Contents

Page

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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire containment*.

ISO 834 consists of the following parts, under the general title *Fire resistance tests — Elements of building construction*:

— *Part 1: General requirements*

— *Part 2: Guidance on measuring uniformity of furnace exposure on test samples* [Technical Report]

— *Part 3: Commentary on test method and guide to the application of the outputs from the fire-resistance test* [Technical Report]

— *Part 4: Specific requirements for loadbearing vertical separating elements*

— *Part 5: Specific requirements for loadbearing horizontal separating elements*

— *Part 6: Specific requirements for beams*

— *Part 7: Specific requirements for columns*

— *Part 8: Specific requirements for non-loadbearing vertical separating elements*

— *Part 9: Specific requirements for non-loadbearing ceiling elements*

— *Part 10: Specific requirements to determine the contribution of applied fire protection materials to structural steel elements*

— *Part 11: Specific requirements for the assessment of fire protection to structural steel elements*

— *Part 12: Specific requirements for separating elements evaluated on less than full scale furnaces*

Introduction

Technological advances in the fire protection of structural steelwork have resulted in a range of materials being developed that are now in widespread use throughout the building construction industry. These are broadly categorized as intumescent coatings, sprays, renders, and boards and are often referred to as lightweight systems in comparison to the some of the more traditional materials such as brick, block, and concrete.

Fire protection materials reduce the rate of temperature rise of steel members when exposed to fire by a variety of methods. Apart from influencing heat transfer mechanism, such as conduction, convection, and radiation, they often involve thermo-physical transformations, exothermic chemical reactions, as well as shape changes that increase the thickness of the material and delay the rate at which the underlying steel substrate heats up. Relatively simple changes such as the release of free moisture at around 100 °C, or water of crystallization and sublimation, which all occur within specific temperature ranges, often result in a plateau of rising temperature versus time of varying magnitude depending upon the type of material and even the way in which it is applied to the steel substrate.

Understanding the behaviour of fire protection materials is complicated, not least when the physical/chemical reactions and changes in thermal properties occur at different temperatures and at different rates, depending on their chemical constitution and reaction temperature. This makes the development of suitable standards for testing and quantifying their behaviour as insulation materials difficult.

In addition, with recent advances in structural fire engineering in which steel members are no longer considered to fail at a unique temperature, information on fire protection thicknesses is a requirement that can be specified over a range of limiting temperatures depending upon the type of loading system (bending, shear, tension, and compression), the magnitude of the applied loads, and the degree of exposure of the surface with respect to the fire/furnace.

Therefore, to rationalize the behaviour of fire protection products for protecting structural steelwork into simple design tables that manufacturers can use to specify their products involves the permutation of a large number of parameters.

In Europe, the development of testing and assessment protocols for fire protecting structural steel commenced during the 1990s under a European mandate within CEN TC127 (Fire resistance tests) and was the beginning of drafting European standards such as DD ENV YYY5. Since then, fire protection manufacturers in collaboration with the test laboratories throughout Europe have developed a series of test packages and assessment methods over the past 15 years which have been through a rigorous appraisal process by the fire protection industry. This work has culminated in the drafting of EN 13381 Parts 4 and 8 which broadly cover passive and reactive products.

Some of the key issues in developing these standards have been identifying the number of specimens required in a test package to characterize the performance of a fire protection product over the range of fire resistance times, applicable section factors, type of structural element, and design temperature. In addition, because of the vagaries in fire resistance testing, it has been necessary to establish a rationale for applying correction factors to the test results for use in the assessment process partly to maximize the validity of the data and keep the costs of testing to a minimum.

In Europe, four assessment methods have been developed, referred to as Graphical method, Differential equation analysis (variable l), Differential equation analysis (constant l), and Numerical regression analysis. Each method has been through a process of validation and are now included in the standards EN 13381 Parts 4 and 8.

In this part of ISO 834, the four methods have been directly incorporated into the standard and technically are identical to the European counterparts. However, it is recognized that other assessment methods may be suitable and therefore this part of ISO 834 provides a set of criteria for their acceptability. One such method which has undergone an evaluation process and meets the criteria for acceptability is the 3D method developed in the UK and currently used for reactive materials.

The 3D assessment was formerly presented as a published research paper at the SC2/WG2 meeting in Kyoto, Japan in November 2006 (N414). Since 2006, it has been published and presented in various forms in the technical journals and seminars and is now included in the Dutch Standard NEN 7878 (2011) and the Dutch Fire Safety Handbook (2011).

This part of ISO 834 recognizes that some assessment method/s are more suited to particular types of fire protection materials, and for this reason, they are presented as Informative Annexes, which enables freedom of choice in their application. However, only a single method can be used for the assessment process for a particular data set and cannot be mixed.

This part of ISO 834 specifies methods for assessing fire protection systems applied to structural steel members, employed in buildings as beams, columns, or tension members. This part of ISO 834 is intended for use in conjunction with the testing described in ISO 834-10.

Fire resistance tests — Elements of building construction —

Part 11:
Specific requirements for the assessment of fire protection to structural steel elements

1 Scope

The assessment detailed in this part of ISO 834 is designed to cover a range of thicknesses of the fire protection material, a range of steel sections characterized by their section factors, a range of design temperatures, and a range of valid fire resistance classification periods.

This part of ISO 834 covers fire protection systems that include both passive (boards, mats, slabs, and spray materials) and reactive materials as defined in this document.

The assessment procedure is used to establish

a) on the basis of the temperature data derived from testing loaded and unloaded specimens, a correction factor and practical constraints on the use of the fire protection system (the physical performance) and

b) on the basis of the temperature data derived from testing unloaded short steel specimens, the thermal properties of the fire protection material (the thermal performance).

The limits of applicability of the results of the assessment are defined together with permitted direct application of the results to different steel section sizes and strength grades (but not stainless steels) and to the fire protection system tested. The results of the tests obtained according to ISO 834-10 and the assessment in this part of ISO 834 are directly applicable to steel sections of “I” and “H” cross-sectional shape and hollow sections. Results from analysis of I or H sections are directly applicable to angles, channels, and T-sections for the same section factor, whether used as individual elements or as part of a fabricated steel truss.

The results of the assessment are applicable to fabricated sections.

This part of ISO 834 does not apply to concrete-filled hollow sections, beams, or columns containing holes or openings of any type or solid bar.

Any assessment method is acceptable provided it meets the acceptability criteria given in 5.5. Examples of assessment methods in common use are given in Annexes C to G.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *Fire-resistance tests — Elements of building construction — Part 1: General requirements*

ISO 834-10, *Fire resistance tests — Elements of building construction — Part 10: Specific requirements to determine the contribution of applied fire protection materials to structural elements*

ISO 8421-2, *Fire protection — Vocabulary — Part 2: Structural fire protection*

ISO 13943, *Fire safety — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 834-1, ISO 13943, ISO 8421-2, and the following apply.

3.1
characteristic steel temperature
temperature of the structural steel member which is used for the determination of the correction factor for stickability which is calculated according to 5.2.2

3.2
design temperature
temperature of the steel member for structural design purposes

3.3
fire protection
protection afforded to the steel member by the fire protection system such that the temperature of the steel member is limited throughout the period of fire exposure

3.4
fire protection system
fire protection material together with any supporting system including mesh reinforcement as tested

Note 1 to entry: The reactive fire protection materials system includes the primer and top coat if applicable.

3.5
fire protection thickness
dry thickness of a single-layer fire protection system or the combined thickness of all layers of a fire protection system

Note 1 to entry: The thickness of elements of the supporting system or joint cover strips is not included in the fire protection thickness.

Note 2 to entry: For reactive fire protection systems, the thickness is the mean dry film thickness of the coating excluding primer and top coat if applicable.

3.6
H section
steel member with wide flanges compared with the section depth whose main function is to carry axial loads parallel to its longitudinal axis which can be combined with bending and shear

3.7
I section
steel joist or girder with short flanges shaped like a letter "I" whose main function is to carry loads transverse to its longitudinal axis

Note 1 to entry: These loads usually cause bending of the beam member. The flanges may be parallel or tapered.

3.8
passive fire protection material
material, which do not change their physical form on heating, providing protection by virtue of their physical or thermal properties

Note 1 to entry: Passive fire protection materials may include materials containing water or undergo endothermic reactions which, on heating produce cooling effects. These may take the form of sprayed coatings, renderings, mat products, boards, or slabs.