SLOVENSKI STANDARD
SIST EN 1999-1-2:2007

01-maj-2007

Nadomeġļ a:
SIST ENV 1999-1-2:2002

Evrokod 9 - Projektiranje konstrukcij iz aluminijevih zlitin - 1-2. del: Splošna pravila - Projektiranje požarnovarnih konstrukcij

Eurocode 9 - Design of aluminium structures - Part 1-2: Structural fire design

Eurocode 9 - Bemessung und Konstruktion von Aluminiumtragwerken - Teil 1-2: Tragwerksbemessung für den Brandfall

Eurocode 9 - Calcul des structures en aluminium - Partie 1-2: Calcul du comportement au feu

Ta slovenski standard je istoveten z: **EN 1999-1-2:2007**

ICS:

13.220.50	Požarna odpornost gradbenih materialov in elementov	Fire-resistance of building materials and elements
91.010.30	Tehniļ ni vidiki	Technical aspects
91.080.10	Kovinske konstrukcije	Metal structures

SIST EN 1999-1-2:2007 **en;fr;de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1999-1-2

February 2007

ICS 91.010.30; 91.080.10

Supersedes ENV 1999-1-2:1998

English Version

Eurocode 9 - Design of aluminium structures - Part 1-2: Structural fire design

Eurocode 9 - Calcul des structures en aluminium - Partie 1-2: Calcul du comportement au feu

Eurocode 9 - Bemessung und Konstruktion von Aluminiumtragwerken - Teil 1-2: Tragwerksbemessung für den Brandfall

This European Standard was approved by CEN on 18 September 2006.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 1999-1-2:2007: E

Contents

Page

Foreword

This European Standard (EN 1999-1-2:2007) has been prepared by Technical Committee CEN/TC 250 “Structural Eurocodes”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2007, and conflicting national standard shall be withdrawn at the latest by March 2010.

This European Standard supersedes ENV 1999-1-2:1998

CEN/TC 250 is responsible for all Structural Eurocodes

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Background of the Eurocode programme

In 1975, the Commission of the European Community decided on an action programme in the field of construction, based on article 95 of the Treaty. The objective of the programme was the elimination of technical obstacles to trade and the harmonisation of technical specifications.

Within this action programme, the Commission took the initiative to establish a set of harmonised technical rules for the design of construction works which, in a first stage, would serve as an alternative to the national rules in force in the Member States and, ultimately, would replace them.

For fifteen years, the Commission, with the help of a Steering Committee with Representatives of Member States, conducted the development of the Eurocodes programme, which led to the first generation of European codes in the 1980s.

In 1989, the Commission and the Member States of the EU and EFTA decided, on the basis of an agreement[1] between the Commission and CEN, to transfer the preparation and the publication of the Eurocodes to the CEN through a series of Mandates, in order to provide them with a future status of European Standard (EN). This links de facto the Eurocodes with the provisions of all the Council’s Directives and/or Commission’s Decisions dealing with European standards (e.g. the Council Directive 89/106/EEC on construction products - CPD - and Council Directives 93/37/EEC, 92/50/EEC and 89/440/EEC on public works and services and equivalent EFTA Directives initiated in pursuit of setting up the internal market).

The Structural Eurocode programme comprises the following standards generally consisting of a number of Parts:

EN 1990	Eurocode 0:	Basis of Structural Design
EN 1991	Eurocode 1:	Actions on structures

[1] Agreement between the Commission of the European Communities and the European Committee for Standardisation (CEN) concerning the work on EUROCODES for the design of building and civil engineering works (BC/CEN/03/89).

EN 1992	Eurocode 2:	Design of concrete structures
EN 1993	Eurocode 3:	Design of steel structures
EN 1994	Eurocode 4:	Design of composite steel and concrete structures
EN 1995	Eurocode 5:	Design of timber structures
EN 1996	Eurocode 6:	Design of masonry structures
EN 1997	Eurocode 7:	Geotechnical design
EN 1998	Eurocode 8:	Design of structures for earthquake resistance
EN 1999	Eurocode 9:	Design of aluminium structures

Eurocode standards recognise the responsibility of regulatory authorities in each Member State and have safeguarded their right to determine values related to regulatory safety matters at national level where these continue to vary from State to State.

Status and field of application of Eurocodes

The Member States of the EU and EFTA recognise that Eurocodes serve as reference documents for the following purposes:

. as a means to prove compliance of building and civil engineering works with the essential requirements of Council Directive 89/106/EEC, particularly Essential Requirement No.1 – Mechanical resistance and stability, and Essential Requirement No.2 – Safety in case of fire

. as a basis for specifying contracts for the execution of construction works and related engineering services

. as a framework for drawing up harmonised technical specifications for construction products (En's and ETA's)

The Eurocodes, as far as they concern the construction works themselves, have a direct relationship with the Interpretative Documents[2] referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards[3]. Therefore, technical aspects arising from the Eurocodes work need to be adequately considered by CEN Technical Committees and/or EOTA Working Groups working on product standards with a view to achieving full compatibility of these technical specifications with the Eurocodes.

The Eurocode standards provide common structural design rules for everyday use for the design of whole structures and component products of both a traditional and an innovative nature. Unusual forms of construction or design conditions are not specifically covered and additional expert consideration will be required by the designer in such cases.

---

[2] According to Art. 3.3 of the CPD, the essential requirements (ERs) shall be given concrete form in interpretative documents for the creation of the necessary links between the essential requirements and the mandates for harmonised ENs and ETAGs/ETAs.

[3] According to Art. 12 of the CPD the interpretative documents shall :

a) give concrete form to the essential requirements by harmonising the terminology and the technical bases and indicating classes or levels for each requirement where necessary ;
b) indicate methods of correlating these classes or levels of requirement with the technical specifications, e.g. methods of calculation and of proof, technical rules for project design, etc. ;
c) serve as a reference for the establishment of harmonised standards and guidelines for European technical approvals.

The Eurocodes, *de facto*, play a similar role in the field of the ER 1 and a part of ER 2.

National standards implementing Eurocodes

The National Standards implementing Eurocodes will comprise the full text of the Eurocode (including any Annexes), as published by CEN, which may be preceded by a National title page and National foreword, and may be followed by a National Annex (informative).

The National Annex (informative) may only contain information on those parameters which are left open in the Eurocode for national choice, known as Nationally Determined Parameters, to be used for the design of buildings and civil engineering works to be constructed in the country concerned, i.e.:

. values for partial factors and/or classes where alternatives are given in the Eurocode;

. values to be used where a symbol only is given in the Eurocode;

. geographical and climatic data specific to the Member State, e.g. snow map;

. the procedure to be used where alternative procedures are given in the Eurocode;

. references to non-contradictory complementary information to assist the user to apply the Eurocode.

Links between Eurocodes and harmonised technical specifications (EN's and ETA's) for products

There is a need for consistency between the harmonised technical specifications for construction products and the technical rules for works[4]. Furthermore, all the information accompanying the CE Marking of the construction products which refer to Eurocodes shall clearly mention which Nationally Determined Parameters have been taken into account.

Additional information specific to EN 1999-1-2

EN 1999-1-2 describes the principles, requirements and rules for the structural design of buildings exposed to fire, including the following aspects.

Safety requirements

EN 1999-1-2 is intended for owners of construction works (e.g. for the formulation of their specific requirements), designers, contractors and relevant authorities.

The general objectives of fire protection are to limit risks with respect to the individual and society, neighbouring property, and where required, environment or directly exposed property, in the case of fire.

Construction Products Directive 89/106/EEC gives the following essential requirement for the limitation of fire risks:

"The construction works must be designed and build in such a way, that in the event of an outbreak of fire

. the load bearing resistance of the construction can be assumed for a specified period of time;

. the generation and spread of fire and smoke within the works are limited;

. the spread of fire to neighbouring construction works is limited;

[4] see Art.3.3 and Art.12 of the CPD, as well as clauses 4.2, 4.3.1, 4.3.2 and 5.2 of ID 1.

. the occupants can leave the works or can be rescued by other means;

. the safety of rescue teams is taken into consideration".

According to the Interpretative Document N° 2 "Safety in case of fire[5]" the essential requirement may be observed by following various possibilities for fire safety strategies prevailing in the Member States like conventional fire scenarios (nominal fires) or "natural" (parametric) fire scenarios, including passive and/or active fire protection measures.

The fire parts of Structural Eurocodes deal with specific aspects of passive fire protection in terms of designing structures and parts thereof for adequate load bearing resistance and for limiting fire spread as relevant.

Required functions and levels of performance can be specified either in terms of nominal (standard) fire resistance rating, generally given in national fire regulations or by referring to fire safety engineering for assessing passive and active measures.

Supplementary requirements concerning, for example

. the possible installation and maintenance of sprinkler systems;

. conditions on occupancy of building or fire compartment;

. the use of approved insulation and coating materials, including their maintenance.

are not given in this document, because they are subject to specification by the competent authority.

Numerical values for partial factors and other reliability elements are given as recommended values that provide an acceptable level of reliability. They have been selected assuming that an appropriate level of workmanship and of quality management applies.

Design procedures

A full analytical procedure for structural fire design would take into account the behaviour of the structural system at elevated temperatures, the potential heat exposure and the beneficial effects of active and passive fire protection systems, together with the uncertainties associated with these three features and the importance of the structure (consequences of failure).

At the present time it is possible to undertake a procedure for determining adequate performance which incorporates some, if not all, of these parameters and to demonstrate that the structure, or its components, will give adequate performance in a real building fire. However, where the procedure is based on a nominal (standard) fire the classification system, which call for specific periods of fire resistance, takes into account (though not explicitly), the features and uncertainties described above.

The design procedure for structural fire design is illustrated in Figure 0.1. The prescriptive approach and the performance-based approach are identified. The prescriptive approach uses nominal fires to generate thermal actions. The performance-based approach, using fire safety engineering, refers to thermal actions based on physical and chemical parameters.

NOTE Tabulated data, as shown in Figure 0.1, are not available for aluminium components.

For design according to this part, EN 1991-1-2 is required for the determination of thermal and mechanical actions to the structure.

[5] see clause 2.2, 3.2(4) and 4.2.3.3

Design aids

It is expected, that design aids based on the calculation models given in EN 1999-1-2, will be prepared by interested external organizations.

The main text of EN 1999-1-2 together with normative Annexes includes most of the principal concepts and rules necessary for structural fire design of aluminium structures.

National Annex for EN 1999-1-2

This standard gives alternative procedures, values and recommendations for classes with notes indicating where national choices may have to be made. Therefore the National Standard implementing EN 1999-1-2 should have a National Annex containing the Eurocode all Nationally Determined Parameters to be used for the design of buildings and civil engineering works to be constructed in the relevant country.

National choice is allowed in EN 1999-1-2 through clauses:

2.3 (1)

2.3 (2)

2.4.2 (3)

4.2.2.1 (1)

4.2.2.3 (5)

4.2.2.4 (5)

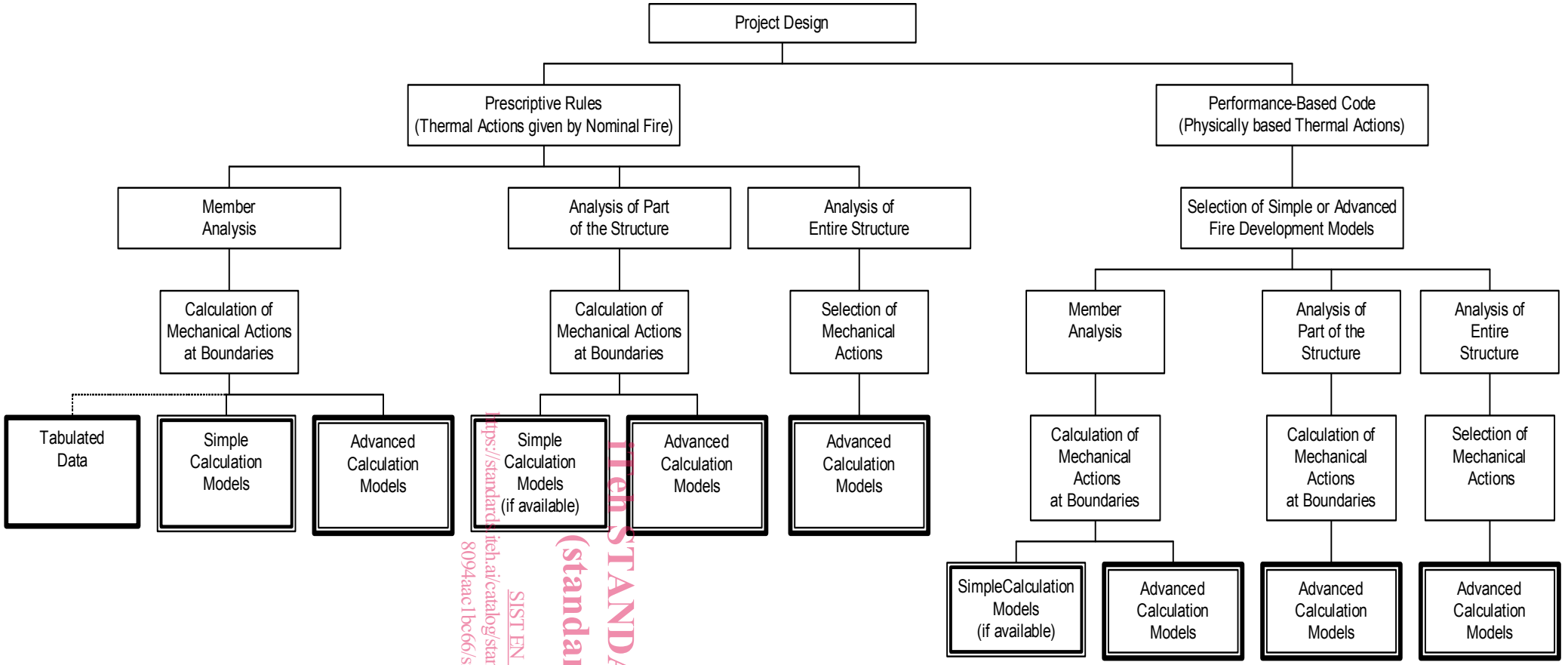

Figure 0.1 – A general illustration of the design procedure for structural fire design

1 General

1.1 Scope

1.1.1 Scope of EN 1999

(1)P EN 1999 applies to the design of buildings and civil engineering works in aluminium. It complies with the principles and requirements for the safety and serviceability of structures, the basis of their design and verification that are given in EN 1990 – Basis of structural design.

(2)P EN 1999 is only concerned with requirements for resistance, serviceability, durability and fire resistance of aluminium structures. Other requirements, e.g. concerning thermal or sound insulation, are not considered.

(3) EN 1999 is intended to be used in conjunction with:

. EN 1990 “Basis of structural design”

. EN 1991 “Actions on structures”, all relevant parts

. European Standards for construction products relevant for aluminium structures

. EN 1998 “Design of structures for earthquake resistance”, where aluminium structures are built in seismic regions

(4) EN 1999 is subdivided in five parts:

. EN 1999-1-1 Design of aluminium structures: General structural rules

. EN 1999-1-2 Design of aluminium structures: Structural fire design

. EN 1999-1-3 Design of aluminium structures: Structures susceptible to fatigue

. EN 1999-1-4 Design of aluminium structures: Cold formed structural sheeting

. EN 1999-1-5 Design of aluminium structures: Shell structures

1.1.2 Scope of EN 1999-1-2

(1) EN 1999-1-2 deals with the design of aluminium structures for the accidental situation of fire exposure and is intended to be used in conjunction with EN 1999-1-1 and EN 1991-1-2. EN1999-1-2 only identifies differences from, or supplements to, normal temperature design.

(2) EN 1999-1-2 deals only with passive methods of fire protection. Active methods are not covered.

(3) EN 1999-1-2 applies to aluminium structures that are required to fulfil load bearing function if exposed to fire, in terms of avoiding premature collapse of the structure.

NOTE This part does not include rules for separating elements.

(4) EN 1999-1-2 gives principles and application rules for design of structures for specified requirements in respect of the load bearing function and the levels of performance.

(5) EN 1999-1-2 applies to structures, or parts of structures, that are within the scope of EN 1999-1-1 and are designed accordingly.

(6) The aluminium alloy properties given in the Part 1-2 of EN 1999 apply to the following aluminium alloys:

EN AW-3004 – H34	EN AW-5083 – O and H12	EN AW-6063 – T5 and T6
EN AW-5005 – O and H34	EN AW-5454 – O and H34	EN AW-6082 – T4 and T6
EN AW-5052 – H34	EN AW-6061 – T6	

(7) The methods given in EN 1999-1-2 are applicable also to the other aluminium alloy/tempers of EN 1999-1-1 if reliable material properties at elevated temperatures are available or the simplified assumptions in 3.2.1 are applied.

1.2 Normative references

(1) This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only if incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 485-2 Aluminium and aluminium alloys. Sheet, strip and plate. Part 2: Mechanical properties

EN 755-2 Aluminium and aluminium alloys. Extruded rod/bar, tube and profiles. Part 2: Mechanical properties

EN 1990 Basis of structural design

EN 1991-1-2 Basis of design and actions on structures Part 1-2: Actions on structures exposed to fire

EN 1999-1-1 Design of aluminium structures: Part 1-1: General structural rules

EN 1090-3[6] Execution of steel structures and aluminium structures – Part 3: Technical requirements for aluminium structures

EN 13501-2 Fire classification of construction products and building elements. Part 2 Classification using data from fire resistance tests

ENV 13381-1 Fire tests on elements of building construction: Part 1: Test method for determining the contribution to the fire resistance of structural members: By horizontal protective membranes

ENV 13381-2 Fire tests on elements of building construction. Part 2: Test method for determining the contribution to the fire resistance of structural members: By vertical protective membranes.

ENV 13381-4 Fire tests on elements of building construction. Part 4: Test method for determining the contribution to the fire resistance of structural members: By applied protection to steel structural elements.

1.3 Assumptions

(1) In addition to the general assumptions of EN 1990 the following assumption applies:
Any passive fire protection systems taken into account in the design will be adequately maintained.

1.4 Distinction between principles and application rules

(1) The rules given in EN 1990 1.4 apply.

[6] to be published

1.5 Terms and definitions

(1) The rules in EN 1990 1.5 apply.

(2) The following terms are used in EN 1999-1-2 with the following meanings:

1.5.1 Special terms relating to design in general

1.5.1.1
part of structure
isolated part of an entire structure with appropriate support and boundary conditions

1.5.1.2
protected members
members for which measures are taken to reduce the temperature rise in the member due to fire

1.5.2 Terms relating to thermal actions

1.5.2.1
standard temperature-time curve
a nominal curve, defined in EN 13501-2 for representing a model of a fully developed fire in a compartment

1.5.2.2
temperature-time curves
gas temperature in the environment of member surfaces as a function of time. They may be:

- **nominal:** Conventional curves, adopted for classification or verification of fire resistance, e.g. the standard temperature-time curve, external fire curve, hydrocarbon fire curve;

- **parametric:** Determined on the basis of fire models and the specific physical parameters defining the conditions in the fire compartment

1.5.3 Terms relating to material and products

1.5.3.1
fire protection material
any material or combination of materials applied to a structural member for the purpose of increasing its fire resistance

1.5.4 Terms relating to heat transfer analysis

1.5.4.1
configuration factor
the configuration factor for radiative heat transfer from surface A to surface B is defined as the fraction of diffusely radiated energy leaving surface A that is incident on surface B

1.5.4.2
convective heat transfer coefficient
convective heat flux to the member related to the difference between the bulk temperature of gas bordering the relevant surface of the member and the temperature of that surface

1.5.4.3
emissivity
equal to absorptivity of a surface, i.e. the ratio between the radiative heat absorbed by a given surface, and that of a black body surface

1.5.4.4
net heat flux
energy per unit time and surface area definitely absorbed by members

1.5.4.5
resulting emissivity
the ratio between the actual radiative heat flux to the member and the net heat flux that would occur if the member and its radiative environment were considered as black bodies

1.5.4.6
section factor
for an aluminium member, the ratio between the exposed surface area and the volume of aluminium; for an enclosed member, the ratio between the internal surface area of the exposed encasement and the volume of aluminium

1.5.4.7
box value of section factor
ratio between the exposed surface area of a notional bounding box for the section to the volume of aluminium

1.5.5 Terms relating to mechanical behaviour analysis

1.5.5.1
critical temperature of a structural aluminium member
for a given load level, the temperature at which failure is expected to occur in a structural aluminium member for a uniform temperature distribution

1.5.5.2
effective 0,2 % proof strength

for a given temperature, the stress level at which the stress-strain relationship of aluminium gives a 0,2 % permanent strain

1.5.5.3
external member
structural member located outside the building that can be exposed to fire through openings in the building enclosure

1.6 Symbols

(1) For the purpose of EN 1999-1-2, the following symbols apply in addition to those given in EN 1999-1-1:

Latin upper case letters

A_m the exposed surface area of a member per unit length

A_p the area of the inner surface of the fire protection material per unit length of the member

E_{al} the modulus of elasticity of aluminium for normal temperature design

$E_{al,.}$ the modulus of elasticity for aluminium at elevated temperature, $._{al}$

V the volume of a member per unit length

Latin lower case letters

c_{al} the specific heat of aluminium

c_p the specific heat of the fire protection material