SLOVENSKI PREDSTANDARD

SIST ENV 1999-1-2

prva izdaja
oktober 2002

Eurocode 9 - Projektiranje konstrukcij iz aluminijevih zlitin - Del 1-2: Splošna pravila - Projektiranje požarnovarnih konstrukcij (prevzet ENV 1999-1-2:1998 z metodo platnice)

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

Eurocode 9 - Conception et dimensionnement des structures en aluminium - Partie 1-2: Règles générales - Calcul du comportement au feu

Eurocode 9 - Bemessung und Konstruktion von Aluminiumbauten - Teil 1-2: Allgemeine Regeln - Tragwerksbemessung für den Brandfall

Deskriptorji: gradbeništvo, stavbe, jeklena konstrukcija, aluminij, aluminijasta konstrukcija, projektiranje, predpisi za gradnjo, računanje, požarna odpornost

ICS 13.220.50; 91.010.30; 91.080.10

Referenčna številka
SIST ENV 1999-1-2:2002 ((sl),en)

Nadaljevanje na straneh od II do IV in od 1 do 56

NACIONALNI UVOD

Predstandard SIST ENV 1999-1-2 ((sl),en), Eurocode 9 - Projektiranje konstrukcij iz aluminijevih zlitin - Del 1-2: Splošna pravila - Projektiranje požarnovarnih konstrukcij, prva izdaja, 2002, ima status slovenskega predstandarda in je z metodo platnice prevzet evropski predstandard ENV 1998-1-2 (en), Eurocode 9 - Design of aluminium structures - Part 1-2: General rules - Structural fire design, May 1998.

NACIONALNI PREDGOVOR

Evropski predstandard ENV 1999-1-2:1998 je pripravil tehnični odbor Evropskega komiteja za standardizacijo CEN/TC 250 Konstrukcijski Evrokodi.

Odločitev za prevzem tega predstandarda po metodi platnice je sprejela delovna skupina WG 9 Aluminijaste konstrukcije, ki je pripravila tudi nacionalni dokument za uporabo v Sloveniji, potrdil pa tehnični odbor TC KON Konstrukcije.

Ta slovenski predstandard se lahko uporablja samo v skladu z nacionalnim dokumentom, ki je sestavni del SIST ENV 1999-1-2:2002.

Ta slovenski predstandard je dne 2002-09-02 odobrila direktorica SIST.

Rok veljavnosti tega predstandarda je do izdaje evropskega standarda EN 1999-1-2.

DELI EVROKODA 9 (EC 9 OZIROMA ENV 1999) SPREJETI V NACIONALNO STANDARDIZACIJO:

SIST ENV 1999-1-1:2002	((sl),en)	Eurocode 9 - Projektiranje konstrukcij iz aluminijevih zlitin - Del 1-1: Splošna pravila - Splošna pravila in pravila za stavbe
SIST ENV 1999-2:2002	((sl),en)	Eurocode 9 - Projektiranje konstrukcij iz aluminijevih zlitin - 2. del: Konstrukcije, občutljive na utrujanje

OPOMBI

- Povsod, kjer se v besedilu predstandarda uporablja izraz “evropski predstandard”, v SIST ENV 1999-1-2:2002 to pomeni “slovenski predstandard”.
- Nacionalni uvod in nacionalni predgovor nista sestavni del predstandarda.

VSEBINA **Stran**

NACIONALNI DOKUMENT ZA UPORABO V SLOVENIJI

Ta predstandard se uporablja z naslednjimi parametri:

Za vrednosti parametrov, podanih v okvirju (večinoma delni varnostni faktorji odpornosti ali zunanjih vplivov), se v SIST ENV 1999-1-2:2002 privzamejo priporočene vrednosti, podane v ENV 1999-1-2:1998.

V tem predstandardu se za prevajanje uporabljajo naslednji enakovredni izrazi, skupni vsem Eurocode:

construction works	gradbeni objekt, zgradba
execution	izvedba
structure	nosilna konstrukcija
type of building or civil and structural engineering works	vrsta stavb in inženirskih objektov
form of structure	tip konstrukcije
construction material	gradbeni material
type of construction	vrsta gradnje
method of construction	postopek gradnje
structural system	sistem nosilne konstrukcije

EUROPEAN PRESTANDARD
PRÉNORME EUROPÉENNE
EUROPÄISCHE VORNORM

ENV 1999-1-2

May 1998

ICS 13.220.50; 91.010.30; 91.080.10

Descriptors: civil engineering, buildings, steel construction, aluminium, design, building codes, computation, fire resistance

English version

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

Eurocode 9: Conception et dimensionnement des structures en aluminium - Partie 1-2: Règles générales - Calcul du comportement au feu

Eurocode 9: Bemessung und Konstruktion von Aluminiumbauten - Teil 1-2: Allgemeine Regeln - Tragwerksbemessung für den Brandfall

This European Prestandard (ENV) was approved by CEN on 26 October 1997 as a prospective standard for provisional application.

The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard.

CEN members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Contents

Foreword

Objectives of the Eurocodes

The "Structural Eurocodes" comprise a group of standards for the structural and geotechnical design of buildings and civil engineering works.

They are intended to serve as reference documents for the following purposes:

a) As a means to prove compliance of building and civil engineering works with the essential requirements of the Construction Products Directive (CPD).

b) As a framework for drawing up harmonised technical specifications for construction products.

They cover execution and control only to the extent that is necessary to indicate the quality of the construction products, and the standard of the workmanship, needed to comply with the assumptions of the design rules.

Until the necessary set of harmonised technical specifications for products and for methods of testing their performance is available, some of the Structural Eurocodes cover some of these aspects in informative annexes.

Background to the Eurocode Programme

The Commission of the European Communities (CEC) initiated the work of establishing a set of harmonised technical rules for the design of building and civil engineering works which initially serve as an alternative to the different rules in force in the various Member States and would ultimately replace them. These technical rules became known as the "Structural Eurocodes".

In 1990, after consulting their respective Member States, the CEC transferred the work of further development, issue and updates of the Structural Eurocodes to CEN, and the EFTA Secretariat agreed to support the CEN work.

CEN Technical Committee CEN/TC 250 is responsible for all Structural Eurocodes.

Eurocode programme

Work is in hand on the following Structural Eurocodes, each generally consisting of a number of parts:

EN 1991	Eurocode 1	Basis of design and actions on structures
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

Separate sub-committees have been formed by CEN/TC 250 for the various Eurocodes listed above.

This part of the Structural Eurocode for Design of Aluminium Alloy Structures is being issued by CEN as a European prestandard (ENV) with an initial life of three years.

This European prestandard is intended for experimental practical application in the design of the building and civil engineering works covered by the scope of work as given in 1.1 and for the submission of comments.

After approximately two years CEN members will be invited to submit formal comments to be taken into account in determining future actions.

Meanwhile feedback and comments on this European prestandard should be sent to Secretariat of sub-committee CEN/TC 250/SC 9 at the following address:

Secretariat of CEN/TC 250/SC 9
c/o Norwegian Council for Building Standardization
Postboks 129 Blindern
N-0314 OSLO

or to your national standards organisation.

National Applications Documents

In view of the responsibilities of authorities in member countries for the safety, health and other matters covered by the essential requirements of the CPD, certain safety elements in this ENV have been assigned indicative values which are identified by □. The authorities in each member country are expected to assign definitive values to these safety elements.

Many of the harmonised supporting standards, including the Eurocodes giving values of actions to be taken into account and measures required for fire protection, will not be available by the time this European prestandard is issued. It is therefore anticipated that a National Application Document (NAD) giving definitive values for safety elements, referencing compatible supporting standards and providing national guidance on the application of this European prestandard, will be issued by each member country or its Standards Organisation.

It is intended that this European prestandard is used in conjunction with the NAD valid in the country where the building or civil engineering works are located.

Matters specific to this prestandard

General

The scope of Eurocode 9 is defined in Part 1-1, section 1.1.1 and the scope of this Part of Eurocode 9 is defined in 1.1.

In using this European prestandard in practise, particular regard should be paid to the underlying assumptions and conditions given in Part 1-1, sec. 1.4.

In developing this European prestandard, background documents have been prepared, which give commentaries on, and justifications for, some of the provisions in the European prestandard.

Annexes

This European prestandard is complemented by three Annexes, all informative.

Concept of reference standards

When using this European prestandard reference needs to be made to various CEN and ISO standards. These are used to define the product characteristics and processes which have been assumed to apply in formulating the design rules.

This European prestandard mentions certain "Reference Standards". Where any CEN of ISO standards is not yet available, the National Application Document should be consulted for the standard to be used instead. It is assumed that only those grades and qualities given in section 3 of prENV1999-1-1 will be used for buildings and civil engineering works designed to this European prestandard.

Safety requirements

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

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

Required functions and levels of performance are generally specified by national authorities - mostly in terms of standard fire resistance rating. Where fire safety engineering for assessing passive and active measures is accepted, requirements by authorities may be less prescriptive and allow alternative strategies.

This Part 1-2, together with ENV 1991-2-2, gives the supplements to ENV 1999-1-1 that are necessary so that structures designed according to this set of Structural Eurocodes may also comply with the structural fire resistance requirements.

Supplementary requirements concerning, for example:

- the possible installation and maintenance of sprinkler systems;
- conditions and occupancy of the 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 national authorities.

Normally aluminium alloy structures with requirement for fire resistance, have to be protected. This Part 1-2 has, however, also calculation rules for unprotected aluminium alloy structures exposed to fire. Unprotected aluminium alloy structures may be used for:

- external structures (the walls and the roof of the building protect the structure)
- structures with requirement of 10 or 15 mins. fire resistance (requirements in some countries)
- structures exposed by a thermal load less than the standardized fire load

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 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 that 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, the principal current procedure in European countries is one based on results from standard fire resistance tests. The definition system in national regulations that call for specific periodes of fire resistance, take into account (though not explicity) the features and uncertainties described above.

Due to the limitations of the test method, further tests or analyses may be used. Nevertheless, the results of standard fire tests form the bulk of the input to calculation methods for structural fire design. This European prestandard therefore deals in the main with design for the standard fire resistance.

Design aids

Simple calculation models for aluminium alloy structures are given in this document and accordingly tabulated data are not included. It is expected that tables and other design aids based on the calculation methods given in this European prestandard will be prepared by interested external organisations.

1 General

1.1 Scope

(1)P This European prestandard deals with the design of aluminium alloy structures for the accidental situation of fire exposure and is intended to be used in conjunction with prENV 1999-1-1:1997 and ENV 1991-2-2:1995. This European prestandard only identifies differences from, or supplements to, normal temperature design.

(2)P This document deals only with passive methods of fire protection. Active methods are not covered.

(3)P This European prestandard applies to structures which, for reasons of general fire safety, are required to avoid premature collapse of the structure in exposure to fire (load-bearing function).

(4)P This document only applies to structures or parts of structures which are within the scope of prENV 1999-1-1 and are designed accordingly.

(5)P The methods given in this document are applicable to any aluminium alloys specified in 3.1 (1).

(6)P The aluminium alloy properties given in this document apply to the following aluminium alloys:

EN AW-5052	EN AW-5454	EN AW-6063
EN AW-5083	EN AW-6061	EN AW-6082

1.2 Distinction between Principles and Application Rules

(1) Depending on the character of the individual clauses, distinction is made in this Eurocode between Principles and Application Rules.

(2) The Principles comprise:

- general statements and definitions for which there is no alternative, as well as
- requirements and analytical models for which no alternative is permitted unless specifically stated.

(3) The Principles are identified by the letter P following the paragraph number.

(4) The Application Rules are generally recognised rules which follow the Principles and satisfy their requirements.

(5) It is permissible to use alternative design rules different from the Application Rules given in the Eurocode, provided that it is shown that the alternative rule accords with the relevant Principles and is at least equivalent with regard to the resistance, serviceability and durability achieved by the structure.

(6) In this Eurocode the Application Rules are identified by a number in brackets, as in this paragraph.

1.3 Normative references

(1)P This European prestandard 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 below. For undated references the latest edition of the publication referred to applies.

(2)P Normative reference is made to the following CEN standards:

prEN 1363	Fire resistance tests Part 1 General requirements Part 2 Alternative and additional procedures
ENV 1991-1: 1994	Eurocode 1 - Basis of design and actions on structures - Part 1: Basis of design
ENV 1991-2-2: 1994	Eurocode 1 - Basis of design and actions on structures - Part 2-2: Actions on structures imposed to fire
ENV 1999-1-1: 1997	Eurocode 9: Design of aluminium structures - Part 1.1: General rules and rules for buildings
ENV 1999-2:1997	Eurocode 9: Design of aluminium structures - Part 2: Structures susceptible to fatigue

NOTE: A- prENV "Fire test on elements of building construction" is under preparation. The following parts are of importance for this European prestandard:
Part 0 "Test method for determining the contribution to the fire resistance of structural members; general requirements of properties of fire protection materials"
Part 1 "Test method for determining the contribution to the fire resistance of structural members by protective membranes"

(3)P Normative reference is made to the following ISO standard:

ISO 1000:1981 "SI units"

1.4 Definitions

(1)P For the purpose of this European prestandard, the following definitions apply:

configuration factor: Solid angle within which the radiation environment can be seen from a particular point on the member surface, divided by 2π.

NOTE: Information on configuration factors is given in Annex C

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.

critical aluminium alloy temperature: For a given load level, the temperature at which failure is expected to occur in an aluminium alloy element for an uniform temperature distribution.

design fire: A specified fire development assumed for design purposes.

effective 0,2% proof strength: For a given temperature, the stress level at which the stress-strain relationship of aluminium alloy is truncated to provide a (design) yield plateau.

external member: Member located outside the building, which may be exposed to fire through openings in the building enclosure.

fire compartment: A space within a building, extending over one or several floors, which is enclosed by separating members such that fire spread beyond the compartment is prevented during the relevant fire exposure.

fire protection material: A material which has been shown, by fire resistance tests in conformity with prENVs or ENVs

NOTE: See 1.3

to be capable of remaining in position and of providing adequate thermal insulation for the fire resistance period under consideration.

fire resistance: The ability of a member, a structure, or a part of a structure, to fulfil its required functions (load bearing function, and/or separating function) for a specified fire exposure.

global structural analysis (in fire): An analysis of the entire structure, when either all parts of the structure, or only certain parts of it, are exposed to fire. Indirect fire actions are considered throughout the structure.

indirect fire actions: Thermal expansions or thermal deformations causing forces and moments.

load bearing function: The ability of a structure or member to sustain actions during the relevant fire, according to stated criteria.

member analysis (in fire): The thermal and mechanical analysis of a structural member exposed to fire in which the member is considered as isolated, with appropriate support and boundary conditions. Indirect fire actions are not considered, except those resulting from thermal gradients.

normal temperature design: Ultimate limit state design at ambient temperature in accordance with Eurocode 9: Part 1-1 for the fundamental load combination.

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

section factor: For an aluminium alloy member with no protection or with contour protection, 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.

standard fire exposure: Exposure to furnace gases with a temperature which varies with time according to the standard temperature-time curve.

standard fire resistance: Fire resistance for the standard fire exposure for a stated period of time.

NOTE: Normally, standard fire resistance requirements are expressed in periods of time such as 30, 60 or more minutes.

standard temperature time curve: A nominal temperature-time curve in accordance with ENV 1991-2-2:1995.

NOTE: An expression for the standard temperature-time curve is given in ENV 1991-2-2:1995.

structural members: The load-bearing members of a structure, including bracings.

sub-assembly analysis (in fire): The structural analysis of parts of the structure exposed to fire, in which the respective part of the structure is considered as isolated, with appropriate support and boundary conditions. Indirect fire actions within the sub-assembly are considered, but not time-dependent interaction with other parts of the structure.

temperature analysis: The procedure of determining the temperature development in members on the basis of the thermal actions and the thermal material properties of the members and of the protective surfaces, where relevant.

temperature-time curves: Gas temperatures 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 time-temperature curve.

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

thermal actions: Actions on the structure described by the net heat flux to the members.

1.5 Symbols

(1)P Supplementary to ENV 1999-1-1, the following symbols are used:

A_M	is the surface area of a member per unit length (m^2/m)
A_p	is the area of the inner surface of the fire protection material per unit length of the member (m^2/m)
E_{al}	is the modulus of elasticity of aluminium alloy for normal temperature design (MPa)
$E_{al,\theta}$	is the slope of the linear elastic part of the stress versus strain relation- ship for aluminium alloy at elevated temperature θ_{al}. (MPa)
$E_{fi,d}$	is the design effect of actions in the fire situation
$R_{d,\theta}$	is the design resistance at uniform elevated material temperature
$R_{fi,d}$	is the design resistance in the fire situation
$R_{fi,d,t}$	is the design value of a resistance in the fire situation, at time t
T	is the temperature (K) (cf θ temperature (°C))
V	is the volume of a member per unit length (m^3/m)
$X_{fi,d}$	is the design material property in the fire situation
X_k	is the characteristic value of a material property
$X_{k,\theta}$	is the characteristic value of a material property at elevated temperature θ
c	is the specific heat (J/kgK)
d_p	is the thickness of fire protection material (m)
$f_{0.2}$	is the proportional limit for aluminium alloy (MPa)
$f_{p,\theta}$	is the proportional limit for aluminium alloy at elevated temperature θ_{al} (MPa)
$f_{y,\theta}$	is the effective yield strength of aluminium alloy at elevated temperature θ_{al} (MPa)
$h_{net,d}$	is the design value of the net heat flux per unit area (W/m^2)
k_θ	is the relative value of a strength or deformation property of aluminium at elevated temperature θ_{al}
$k_{0.2,\theta}$	is the 0,2% proof stress ratio at elevated temperature θ_{al}
l	is the length at 20 °C (m)
Δl	is the temperature induced expansion (m)
t	is the time in fire exposure (minutes)
Δt	is the time interval (seconds)
η_{fi}	is the reduction factor for design load level in the fire situation
θ	is the temperature (°C) (cf t temperature (K))
κ	is the adaption factor

λ is the thermal conductivy (W/mK)
μ_0 is the degree of utilisation at time $t = 0$
ρ_{al} is the unit mass of aluminium (kg/m^3)

(2)P Supplementary to prENV 1999-1-1, the following subscripts are used:

al aluminium alloy
c connections
fi value relevant for the fire situation
m member
p fire protection material
t dependent on time
θ dependent on temperature

(3) Additional symbols are used in Annexes A to C. These are defined where they first occur.

1.6 Units

(I)P S.I. units shall be used in conformity with ISO 1000:1981.