SLOVENSKI STANDARD
oSIST prEN 1999-1-3:2021

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Evrokod 9: Projektiranje konstrukcij iz aluminijevih zlitin - 1-3. del: Konstrukcije, občutljive na utrujanje

Eurocode 9: Design of aluminium structures - Part 1-3: Structures susceptible to fatigue

Eurocode 9: Bemessung und Konstruktion von Aluminiumtragwerken - Teil 1-3: Ermüdungsbeanspruchte Tragwerke

Eurocode 9 - Calcul des structures en aluminium - Partie 1-3 : Structures sensibles à la fatigue

Ta slovenski standard je istoveten z: prEN 1999-1-3

ICS:

91.010.30	Tehnični vidiki	Technical aspects
91.080.17	Aluminijaste konstrukcije	Aluminium structures

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English Version

Eurocode 9: Design of aluminium structures - Part 1-3: Structures susceptible to fatigue

Eurocode 9 - Calcul des structures en aluminium - Partie 1-3 : Structures sensibles à la fatigue

Eurocode 9: Bemessung und Konstruktion von Aluminiumtragwerken - Teil 1-3: Ermüdungsbeanspruchte Tragwerke

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 250.

If this draft becomes a European Standard, 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.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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European foreword

This document (prEN 1999-1-3:2021) has been prepared by Technical Committee CEN/TC250 “Structural Eurocodes”, the secretariat of which is held by BSI. CEN/TC 250 is responsible for all Structural Eurocodes and has been assigned responsibility for structural and geotechnical design matters by CEN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 1999-1-3:2007.

The first generation of EN Eurocodes was published between 2002 and 2007. This document forms part of the second generation of the Eurocodes, which have been prepared under Mandate M/515 issued to CEN by the European Commission and the European Free Trade Association.

The Eurocodes have been drafted to be used in conjunction with relevant execution, material, product and test standards, and to identify requirements for execution, materials, products and testing that are relied upon by the Eurocodes.

The Eurocodes recognize the responsibility of each member State and have safeguarded their right to determine values related to regulatory safety matters at national level through the use of National Annexes.

Introduction

0.1 Introduction to the Eurocodes

The Structural Eurocodes comprise the following standards generally consisting of a number of Parts:

— EN 1990 Eurocode: Basis of structural and geotechnical design

— EN 1991 Eurocode 1: 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

— < New parts >

The Eurocodes are intended for use by designers, clients, manufacturers, constructors, relevant authorities (in exercising their duties in accordance with national or international regulations), educators, software developers, and committees drafting standards for related product, testing and execution standards.

NOTE Some aspects of design are most appropriately specified by relevant authorities or, where not specified, can be agreed on a project-specific basis between relevant parties such as designers and clients. The Eurocodes identify such aspects making explicit reference to relevant authorities and relevant parties.

0.2 Introduction to EN 1999 Eurocode 9

EN 1999 (all parts) applies to the design of buildings and civil engineering and structural works made of 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.

EN 1999 (all parts) 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.

EN 1999 (all parts) does not cover the special requirements of seismic design. Provisions related to such requirements are given in EN 1998, which complements, and is consistent with EN 1999.

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.

0.3 Introduction to EN 1999-1-3

This document gives the basis for the design of aluminium alloy structures subject to fatigue in the ultimate limit state.

0.4 Verbal forms used in the Eurocodes

The verb "shall" expresses a requirement strictly to be followed and from which no deviation is permitted in order to comply with the Eurocodes.

The verb "should" expresses a highly recommended choice or course of action. Subject to national regulation and/or any relevant contractual provisions, alternative approaches could be used/adopted where technically justified.

The verb "may" expresses a course of action permissible within the limits of the Eurocodes.

The verb "can" expresses possibility and capability; it is used for statements of fact and clarification of concepts.

0.5 National annex for prEN 1999-1-3

National choice is allowed in this document where explicitly stated within notes. National choice includes the selection of values for Nationally Determined Parameters (NDPs).

The national standard implementing EN 1999-1-3 can have a National Annex containing all national choices to be used for the design of buildings and civil engineering works to be constructed in the relevant country.

When no national choice is given, the default choice given in this document is to be used.

When no national choice is made and no default is given in this document, the choice can be specified by a relevant authority or, where not specified, agreed for a specific project by appropriate parties.

National choice is allowed in EN 1999-1-3 through the following clauses:

4.1(2) NOTE

4.3.1(2) NOTE

4.3.2(6) NOTE

4.4(1) NOTE 1

4.4(1) NOTE 2

5(1) NOTE

6(2) NOTE

7.8.1(1) NOTE

7.8.2(1) NOTE 1

8.1.3(1) NOTE 1

8.1.3(1) NOTE 2

8.2.1(2) NOTE 2

8.2.1(6) NOTE

8.2.1(9) NOTE

A.4.1(4) NOTE

A.4.1(5) NOTE

E.2(6) NOTE

E.2(8) NOTE

I.3.2(1) NOTE

I.3.3.2(1) NOTE 2

I.3.4(1) NOTE

L.4.2 (5) NOTE

L.5 (2) NOTE

L.6 (3) NOTE 1

L.6 (3) NOTE 2

L.6 (4) NOTE

L.6 (5) NOTE

L.7.1 (1) NOTE

National choice is allowed in EN 1999-1-3 on the application of the following informative annexes:

Annex B (informative) Guidance on assessment of crack growth by fracture mechanics

Annex C (informative) Testing for fatigue design

Annex D (informative) Stress analysis

Annex E (informative) Adhesively bonded joints

Annex F (informative) Low cycle fatigue range

Annex G (informative) Influence of applied stress ratio R

Annex H (informative) Fatigue strength improvement of welds

Annex I (informative) Castings

Annex J (informative) Detail category tables

Annex K (informative) Hot spot reference detail method

Annex L (informative) Guidance on use of design methods, selection of partial factors, limits for damage values, inspection intervals and execution parameters if Annex J is adopted

The National Annex can contain, directly or by reference, non-contradictory complementary information for ease of implementation, provided it does not alter any provisions of the Eurocodes.

1 Scope

1.1 Scope of EN 1999-1-3

(1) This document gives the basis for the design of aluminium alloy structures subject to fatigue in the ultimate limit state.

(2) This document gives rules for:

— safe life design;

— damage tolerant design;

— design assisted by testing.

(3) This document does not cover pressurized containment vessels or pipework.

1.2 Assumptions

(1) The general assumptions of EN 1990 apply.

(2) The provisions of EN 1999-1-1 apply.

(3) EN 1999-1-3 is intended to be used in conjunction with EN 1990, EN 1991 (all parts), relevant parts in EN 1992 to EN 1999, EN 1090-1 and EN 1090-3 for requirements for execution, and ENs, EADs and ETAs for construction products relevant to aluminium structures.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 1090-3:2019, *Execution of steel structures and aluminium structures - Part 3: Technical requirements for aluminium structures*

EN 1990, *Eurocode - Basis of structural design*

EN 1991 (all parts), *Eurocode 1: Actions on structures (All parts)*

prEN 1999-1-1:2021, *Design of aluminium structures — Part 1-1: General structural rules*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1990 and EN 1999-1-1 and the following apply.

3.1.1
fatigue
weakening of a structural part, through crack initiation and propagation caused by repeated stress fluctuations

3.1.2
fatigue loading
set of typical load events described by the positions or movements of actions, their variation in intensity and their frequency and sequence of occurrence

3.1.3
loading event
defined load sequence applied to the structure, which, for design purposes, is assumed to repeat at a given frequency

3.1.4
nominal stress
stress in the parent material adjacent to a potential crack location, calculated in accordance with simple elastic strength of materials theory, i.e. assuming that plane sections remain plane and that all stress concentration effects are ignored

3.1.5
modified nominal stress
nominal stress increased by an appropriate geometrical stress concentration factor, K_{gt}, to allow only for geometric changes of cross section which have not been taken into account in the classification of a particular constructional detail

3.1.6
geometric stress
structural stress
elastic stress at a point, taking into account all geometrical discontinuities, but ignoring any local singularities where the transition radius tends to zero, such as notches due to small discontinuities, e.g. weld toes, cracks, crack like features, normal machining marks etc., and is in principle the same stress parameter as the modified nominal stress, but generally evaluated by a different method

3.1.7
geometric stress concentration factor
ratio between the geometric stress evaluated with the assumption of linear elastic behaviour of the material and the nominal stress

3.1.8
hot spot stress
geometric stress at a specified initiation site in a particular type of geometry, such as a weld toe in an angle hollow section joint, for which the fatigue strength, expressed in terms of the hot spot stress range, is usually known

3.1.9
stress history
continuous chronological record, either measured or calculated, of the stress variation at a particular point in a structure for a given period of time

3.1.10
stress turning point
value of stress in a stress history where the rate of change of stress changes sign

3.1.11
stress peak
turning point where the rate of change of stress changes from positive to negative

3.1.12
stress valley
turning point where the rate of change of stress changes from negative to positive

3.1.13
constant amplitude
relating to a stress history where the stress alternates between stress peaks and stress valleys of constant values

3.1.14
variable amplitude
relating to any stress history containing more than one value of peak or valley stress

3.1.15
stress cycle
part of a constant amplitude stress history where the stress starts and finishes at the same value but, in doing so passes through one stress peak and one stress valley (in any sequence) and a specific part of a variable amplitude stress history as determined by a cycle counting method

3.1.16
cycle counting
process of transforming a variable amplitude stress history into a spectrum of stress cycles, each with a particular stress range, e.g. the 'rainflow' method and the 'reservoir' method

3.1.17
rainflow method
particular cycle counting method of producing a stress-range spectrum from a given stress history

3.1.18
reservoir method
particular cycle counting method of producing a stress-range spectrum from a given stress history

3.1.19
stress amplitude
half the value of the stress range

3.1.20
stress ratio
minimum stress divided by the maximum stress in a constant amplitude stress history or a cycle derived from a variable amplitude stress history

3.1.21
stress intensity ratio
minimum stress intensity divided by the maximum stress intensity, derived from a constant amplitude stress history or from a cycle in a variable amplitude stress history

3.1.22
mean stress
mean value of the algebraic sum of maximum and minimum stress values

3.1.23
stress range
algebraic difference between the stress peak and the stress valley in a stress cycle