BS EN 1993-1-4:2006+A2:2020

BSI Standards Publication

Eurocode 3 — Design of steel structures

Part 1-4: General rules — Supplementary rules for stainless steels

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National foreword

This British Standard is the UK implementation of EN 1993-1-4:2006+A2:2020. It supersedes BS EN 1993-1-4:2006+A1:2015, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee CB/203, Design & execution of steel structures.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Where a normative part of this EN allows for a choice to be made at national level, the range and possible choice will be given in the normative text, and a note will qualify it as a Nationally Determined Parameter (NDP). NDPs can be a specific value for a factor, a specific level or class, a particular method or a particular application rule if several are proposed in the EN. To enable EN 1993-1-4:2006+A2:2020 to be used in the UK, the latest version of the NA to this Standard containing these NDPs should also be used. At the time of publication, it is NA+A1:2015 to BS EN 1993-1-4:2006+A1:2015.

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Eurocode 3 - Bemessung und Konstruktion von Stahlbauten - Teil 1-4: Allgemeine Bemessungsregeln - Ergänzende Regeln zur Anwendung von nichtrostender Stählen

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European foreword

This European Standard EN 1993-1-4, Eurocode 3: Design of steel structures: Part 1-4 General Rules – Supplementary rules for stainless steels, has been prepared by Technical Committee CEN/TC250 "Structural Eurocodes", the Secretariat of which is held by BSI. CEN/TC250 is responsible for all Structural Eurocodes.
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of an identical text or by endorsement, at the latest by April 2007 and conflicting National Standards shall be withdrawn at latest by March 2010.

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Foreword to amendment A1

This document (EN 1993-1-4:2006/A1:2015) has been prepared by Technical Committee CEN/TC 250 "Structural Eurocodes", the secretariat of which is held by BSI.

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Foreword to amendment A2

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National Annex for EN 1993-1-4

This standard gives alternative procedures, values and recommendations with notes indicating where national choices may have to be made. The National Standard implementing EN 1993-1-4 should have a National Annex containing all Nationally Determined Parameters to be used for the design of steel structures to be constructed in the relevant country.

National choice is allowed in EN 1993-1-4 through clauses:

- 2.1.4(2)
- 2.1.5(1)
- 5.1(2)
- 5.5(1)
- 5.6(2)
- 6.1(2)
- 6.2(3)
- 7(1),
- A.2(8) and
- A.3, Table A.4

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1 General

1.1 Scope

(1) This Part 1.4 of EN 1993 gives supplementary provisions for the design of buildings and civil engineering works that extend and modify the application of EN 1993-1-1, EN 1993-1-3, EN 1993-1-5 and EN 1993-1-8 to austenitic, austenitic-ferritic and ferritic stainless steels.

NOTE 1: Information on the durability of stainless steels is given in Annex A.

NOTE 2: The execution of stainless steel structures is covered in EN 1090.

NOTE 3: Guidelines for further treatment, including heat treatment, are given in EN 10088.

1.2 Normative references

This following normative documents contain provisions which, through reference to this text, constitute provisions of this European Standard. For dated references, subsequent amendments to or revisions of any of these publications do not apply. However, parties to agreements based on this European Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

EN 1990 *Eurocode 0: Basis of structural design*

EN 508-3 *Roofing products from metal sheet. Specification for self-supporting products of steel, aluminium or stainless steel sheet. Stainless steel;*

EN 1090-2 *Execution of steel structures and aluminium structures – Part 2: Technical requirements for steel structures;*

〈A1〉 EN 1993-1-1:2005 〈A1〉 *Design of steel structures: General rules and rules for buildings;*

EN 1993-1-2 *Design of steel structures: Structural fire design;*

EN 1993-1-3 *Design of steel structures: Cold formed thin gauge members and sheeting;*

EN 1993-1-5 *Design of steel structures: Plated structural elements;*

EN 1993-1-6 *Design of steel structures: Strength and stability of shell structures;*

EN 1993-1-8 *Design of steel structures: Design of joints;*

EN 1993-1-9 *Design of steel structures: Fatigue;*

EN 1993-1-10 *Design of steel structures: Material toughness and through-thickness properties;*

EN 1993-1-11 *Design of steel structures: Design of structures with tension components made of steel;*

EN 1993-1-12 *Design of steel structures: Additional rules for the extension of EN 1993 up to steel grades S 700;*

EN ISO 3506-1 *Mechanical properties of corrosion resistant stainless steel fasteners – Part 1: Bolts, screws and studs;*

EN ISO 3506-2 *Mechanical properties of corrosion resistant stainless steel fasteners – Part 2: Nuts*

EN ISO 3506-3 *Mechanical properties of corrosion resistant stainless steel fasteners – Part 3: Set screws and similar fasteners under tensile tests;*

EN ISO 7089 *Plain washers - Normal series - Product grade A;*

EN ISO 7090 *Plain washers, chamfered - Normal series - Product grade A;*

EN ISO 9445 *Continuously cold-rolled stainless steel narrow strip, wide strip, plate/sheet and cut lengths - Tolerances on dimensions and form*

EN 10029 *Specification for tolerances on dimensions, shape and mass for hot rolled steel plates 3 mm thick or above;*

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EN 10052 *Vocabulary of heat treatment terms for ferrous products;*

A1 EN 10088 (all parts) *Stainless steels;* A1

EN 10162 *Cold rolled steel sections. Technical delivery conditions. Dimensional and cross-sectional tolerances;*

EN 10219-2 *Cold formed welded structural sections of non-alloy and fine grain steels. Tolerances, dimensions and sectional properties;*

1.3 Assumptions

(1) In addition to the general assumptions of EN 1990 the following assumptions apply:

- fabrication and erection complies with EN 1090-2.

1.4 Distinction between principles and application rules

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

1.5 Definitions

(1) The rules in EN 1990 clause 1.5 apply.

(2) Unless otherwise stated, the vocabulary of treatment terms for ferrous products used in EN 10052 applies.

1.6 Symbols

In addition to those given in EN 1990, EN 1993-1-1, EN 1993-1-3, EN 1993-1-5 and 1993-1-8, the following symbols are used:

$f_{u,red}$ reduced value of bearing strength
$E_{s,ser}$ secant modulus of elasticity used for serviceability limit state calculations
$E_{s,1}$ secant modulus corresponding to the stress in the tension flange
$E_{s,2}$ secant modulus corresponding to the stress in the compression flange
$\sigma_{1,Ed,ser}$ serviceability design stress
n coefficient

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2 Materials

2.1 Structural stainless steels

2.1.1 General

(1) [A1] The design provisions specified in this Part 1-4 are applicable for stainless steel material in the annealed condition in accordance with Table 2.1 and for austenitic stainless steel material in the cold worked condition in accordance with Table 2.2.

The typical grades used for the construction of building structures are listed in Tables 2.1 and 2.2. The design rules in this standard may also be applied to other grades in EN 10088 -4 and EN 10088 -5, provided the relevant partial factor (γ_M) is increased by 10 %. Specialist advice should be sought regarding the durability, fabrication, weldability, fatigue resistance and high temperature performance of these grades, if appropriate. [A1]

(2) The nominal values of the material properties given in 2.1.2 should be used as characteristic values in structural design calculations.

(3) For further information about material properties reference should be made to EN [A1] standards [A1].

[A1] *Text deleted* [A1]

2.1.2 Material properties for stainless steel

[A1] (1) In design calculations the values should be taken as follows, independent of the direction of rolling:

— yield strength f_y: the nominal stress (0,2 % proof stress) specified in Tables 2.1 and 2.2;

— ultimate tensile strength f_u: the nominal ultimate tensile strength specified in Tables 2.1 and 2.2.

(2) The ductility requirements in EN 1993-1-1:2005, 3.2.2 also apply to stainless steels. Steels conforming with one of the steel grades listed in Table 2.1 should be accepted as satisfying these requirements. The steels listed in Table 2.2 should have declared properties that meet the ductility requirements given in EN 1993-1-1.

(3) Higher strength values, for example derived from cold working the base material, may be used in design provided they are verified by tests in accordance with Clause 7. [A1]

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Table 2.1: Nominal values of the yield strength f_y and the ultimate tensile strength f_u for structural stainless steels to EN 10088 [a]

Type of stainless steel	Grade	Product form							
		Cold rolled strip		Hot rolled strip		Hot rolled plate		Bars, rods and sections	
		Nominal thickness t							
		$t \le 8$ mm		$t \le 13{,}5$ mm		$t \le 75$ mm		$t \le 250$ mm	
		f_y	f_u	f_y	f_u	f_y	f_u	f_y	f_u
		N/mm^2	N/mm^2	N/mm^2	N/mm^2	N/mm^2	N/mm^2	N/mm^2	N/mm^2
Ferritic steels	1.4003	280	450	280	450	250 [c]	450 [c]	260 [d]	450 [d]
	1.4016	260	450	240	450	240 [c]	430 [c]	240 [d]	400 [d]
	1.4512	210	380	210	380	-	-	-	-
Austenitic steels	1.4306	220	520	200	520	200	500	180	460
	1.4307							175	500
	1.4541							190	500
	1.4301	230	540	210	520	210	520		
	1.4401	240	530	220	530	220	520	200	500
	1.4404								
	1.4539							230	530
	1.4571		540		540			200	500
	1.4432	240	550	220	550	220	520		
	1.4435								
	1.4311	290	550	270	550	270	550	270	550
	1.4406	300	580	280	580	280	580	280	580
	1.4439	290		270		270			
	1.4529	-	-	-	-	300	650	300 [b]	650 [b]
	1.4547	320	650	300	650	300	650	300	650
	1.4318	350	650	330	650	330	630	-	-
Austenitic-ferritic steels	1.4062	530 [e]	700 [e]	480 [f]	680 [f]	450 [g]	650 [g]	380 [b]	650 [b]
	1.4162	530 [e]	700 [e]	480 [f]	680 [f]	450	650	450 [b]	650 [b]
	1.4482	500 [e]	700 [e]	480 [f]	660 [f]	450	650	400 [b]	650 [b]
	1.4662	550 [e]	750 [e]	550	750	480	680	450 [b]	650 [b]
	1.4362	450	650	400	650	400	630	400 [b]	600 [b]
	1.4462	500	700	460	700	460	640	450 [b]	650 [b]

[a] The nominal values of f_y and f_u given in this table may be used in design without taking special account of anisotropy or strain hardening effects.

[b] $t \le 160$ mm

[c] $t \le 25$ mm

[d] $t \le 100$ mm

[e] $t \le 6{,}4$ mm

[f] $t \le 10$ mm

[g] $t \le 50$ mm ($f_y = 430$ N/mm^2 and $f_u = 625$ N/mm^2 for 50 mm $< t \le 75$ mm)

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Table 2.2: Nominal values of the yield strength f_y and the ultimate tensile strength f_u for structural stainless steels to EN 10088 in the cold worked condition

Grade	Cold Worked Condition			
	CP350		CP500	
	f_y N/mm^2	f_u [a] N/mm^2	f_y N/mm^2	f_u [a] N/mm^2
1.4301	350	600	460	650
1.4318	[b]	[b]	460	650
1.4541	350	600	460	650
1.4401	350	600	460	650
1.4571	350	600	460	650

[a] According to EN 10088, the CP classification defines only the required 0,2 % proof strength, f_y. The steels used should have declared properties that meet the conservative tabulated values for tensile strength, f_u, unless type testing is used to demonstrate the acceptability of lower values.

[b] Grade 1.4318 develops a 0,2 % proof strength of 350 N/mm^2 in the annealed condition; see Table 2.1.

2.1.3 Design values of material coefficients

(1) The following values of the material coefficients may be assumed for the global analysis and in determining the resistances of members and cross-sections:

- Modulus of elasticity, E:

  E = 200 000 N/mm^2 for the austenitic and austenitic-ferritic grades in Table 2.1 excluding grades 1.4539, 1.4529 and 1.4547

  E = 195 000 N/mm^2 for the austenitic grades 1.4539, 1.4529 and 1.4547

  E = 220 000 N/mm^2 for the ferritic grades in Table 2.1

- Shear modulus, G, where $G = \dfrac{E}{2(1+\nu)}$

- Poisson's ratio in elastic stage, $\nu = 0{,}3$

Alternatively, stress-strain curves according to Annex C may be used for materials in the annealed condition to describe the material behaviour.

(2) For calculating deflections in individual members, the secant modulus appropriate to the stress in the member at the serviceability limit state may be used, see 4.2(5).

2.1.4 Fracture toughness

(1) The austenitic and austenitic-ferritic stainless steels covered in this Part 1.4 may be assumed to be adequately tough and not susceptible to brittle fracture for service temperatures down to -40°C.

NOTE: Austenitic steels may also be used for temperatures below -40°C, but the requirements should be determined for each particular case.

NOTE: See Annex A.5 concerning embrittlement due to contact with zinc in fire.

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