

Stainless steels —

Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes

The European Standard EN 10088-3:1995 has the status of a
British Standard

ICS 77.140.20; 77.140.50

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The preparation of this British Standard was entrusted to Technical Committee ISE/31, Wrought steels, upon which the following bodies were represented:

- Associated Offices Technical Committee
- British Chain Manufacturers' Association
- British Coal Corporation
- British Forging Industry Association
- British Industrial Fasteners Federation
- British Railways Board
- British Steel Industry
- Cold Rolled Sections Association
- Department of Trade and Industry (National Physical Laboratory)
- Engineering Industries Association
- Federation of British Engineers' Tool Manufacturers
- Lloyd's Register of Shipping
- Ministry of Defence
- National Association of Steel Stockholders
- Road Vehicle Spring Society
- Society of Motor Manufacturers and Traders Limited
- Stainless Steel Fabricators' Association of Great Britain

This British Standard, having been prepared under the direction of the Engineering Sector Board, was published under the authority of the Standards Board and comes into effect on 15 November 1995

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The following BSI references relate to the work on this standard:
Committee reference ISE/31
Draft for comment 93/305487 DC

ISBN 0 580 24699 X

Amendments issued since publication

Amd. No	Date	Comments

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National foreword

This Part of BS EN 10088 has been prepared by Technical Committee ISE/31 and is the English language version of EN 10088-3 *Stainless steels* —

Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes published by the European Committee for Standardization (CEN).

Together with BS EN 10088-1 and BS EN 10088-2, this Part of BS EN 10088 partially supersedes BS 970-1:1991, which has been amended.

This Part of BS EN 10088 should be used in preference to BS 970-1 whenever applicable.

Work is continuing in Europe to prepare standards covering boron steels and surface quality.

Cross-references

Publication referred to	Corresponding British Standard
EN 10002-1:1990	BS EN 10002 <i>Tensile testing of metallic materials</i> Part 1:1990 <i>Method of test at ambient temperature</i>
EN 10002-5:1991	Part 5:1992 <i>Method of test at elevated temperatures</i>
EN 10021:1993	BS EN 10021:1993 <i>General technical delivery requirements for steel and iron products</i>
	BS EN 10027 <i>Designation systems for steels</i>
EN 10027-1:1992	Part 1:1992 <i>Steel names, principal symbols</i>
EN 10027-2:1992	Part 2:1992 <i>Steel numbers</i>
	BS EN 10045 <i>Charpy impact test on metallic materials</i>
EN 10045-1:1990	Part 1:1990 <i>Test method (V- and U-notches)</i>
EN 10052:1993	BS EN 10052:1994 <i>Vocabulary of heat treatment terms for ferrous products</i>
EN 10079:1992	BS EN 10079:1993 <i>Definition of steel products</i>
EN 10088-1:1995	BS EN 10088 <i>Stainless steels</i> Part 1:1995 <i>List of stainless steels</i>
EURONORM 114	BS 5903:1980 <i>Method for determination of resistance to intergranular corrosion of austenitic stainless steels: copper sulphate — sulphuric acid method (Moneypenny Strauss test)</i>
EN 10204:1991	BS EN 10204:1991 <i>Metallic products. Types of inspection documents</i>

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 42, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

ICS 77.140.20; 77.140.50

Descriptors: Iron and steel products, hot-rolled products, drawing: forming process, semi-finished products, metal bars, wire rod, metal sections, stainless steels, delivery, designation, dimensions, dimensional tolerances, chemical composition, grades: quality, classifications, mechanical properties, tests marking

English version

Stainless steels — Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes

Aciers inoxydables — Partie 3: Conditions techniques de livraison pour les demi-produits, barres, fils machine et profils pour usage général

Nichtrostende Stähle — Teil 3: Technische Lieferbedingungen für Halbzeug, Stäbe, Walzdraht und Profile für allgemeine Verwendung

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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

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Foreword

This European Standard has been prepared by SC 1, Stainless steels, of Technical Committee ECISS/TC 23, Steels for treatment, alloy steels and free-cutting steels — Qualities, of which the secretariat is held by DIN.

This European Standard replaces:
EU 88-1:1986, *Stainless steels — Part 1: Technical delivery conditions for bars, wire rod and forgings.*

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 October 1995.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

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1 Scope

1.1 This part of EN 10088 specifies the technical delivery conditions for semi-finished products, hot or cold-formed bars, rods and sections of standard grades and special grades of stainless steels for general purposes.

NOTE Here and in the following are understood

- under the term “general purposes”, purposes other than the special purposes mentioned in annex C;
- under the term “standard grades”, grades with a relatively good availability and a wider range of application;
- under the term “special grades”, grades for special use and/or with limited availability.

1.2 The general technical delivery conditions specified in EN 10021 apply in addition to the specifications of this European Standard, unless otherwise specified in this European Standard.

1.3 This European Standard does not apply to components manufactured by further processing the product forms listed in 1.1 with quality characteristics altered as a result of such further processing.

2 Normative references

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 when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 10002-1, *Metallic materials — Tensile testing — Part 1: Method of test (at ambient temperature)*.

EN 10002-5, *Metallic materials — Tensile testing — Part 5: Method of test at elevated temperature*.

EN 10003-1¹⁾, *Metallic materials — Hardness test — Brinell — Part 1: Test method*.

EURONORM 18²⁾, *Selection and preparation of samples and test pieces for steel and iron and steel products*.

EN 10021, *General technical delivery requirements for steel and steel products*.

EN 10027-1, *Designation systems for steels — Part 1: Steel names, principal symbols*.

EN 10027-2, *Designation systems for steels — Part 2: Numerical system*.

EN 10045-1, *Metallic materials — Charpy impact test — Part 1: Method of test*.

EN 10052, *Vocabulary of heat treatment terms for ferrous products*.

EN 10079, *Definition of steel products*.

EN 10088-1, *Stainless steels — Part 1: List of stainless steels*.

EURONORM 114²⁾, *Determination of the resistance to intergranular corrosion of austenitic stainless steels: corrosion test in a sulphuric acid-copper sulphate medium (Moneypenny Strauss test)*.

EURONORM 168²⁾, *Iron and steel products — Inspection documents — Contents*.

EN 10204, *Metallic products — Types of inspection documents*.

EN 10221, *Surface quality classes for hot-rolled bars and rods — Technical delivery conditions*.

See also annex B.

3 Definitions

3.1 stainless steels

the definition in EN 10088-1 applies

3.2 product forms

the definitions in EN 10079 apply

3.3 types of heat treatment

the definitions in EN 10052 apply

4 Dimensions and tolerances on dimensions

The dimensions and the tolerances on dimensions are to be agreed at the time of enquiry and order, as far as possible with reference to the dimensional standards listed in annex B (see also Table 6)

5 Calculation of mass and tolerances on mass

5.1

When calculating the nominal mass from the nominal dimensions, the values given in EN 10088-1 shall be used as a basis for the density of the steel concerned.

5.2

If the tolerances on mass are not specified in the dimensional standard listed in annex B, they may be agreed at the time of enquiry and order.

¹⁾ At present, at the stage of draft

²⁾ It may be agreed at the time of ordering, until this EURONORM has been adopted as a European Standard, that either this EURONORM or a corresponding national standard should be applied.

6 Designation and ordering

6.1 Designation of steel grades

The steel names and steel numbers (see Table 1 to Table 4) were formed in accordance with EN 10027-1 and EN 10027-2 respectively.

6.2 Designation to be used on ordering

The complete designation for ordering a product according to this European Standard shall contain the following information:

- the desired quantity;
- the product form (e.g. bar or rod);
- where an appropriate dimensional standard is available (see annex B), the number of the standard plus any choice of requirements;
- if there is no dimensional standard, the nominal dimensions and tolerances required;
- the type of material (steel);
- the number of this European Standard;
- the steel name or steel number;
- if for the relevant steel in the table for the mechanical properties more than one treatment condition is covered, the symbol for the desired heat treatment or cold-worked condition;
- the desired process route (see symbols in Table 6);
- if an inspection document is required, its designation in accordance with EN 10204.

Example

10 t rounds of a steel grade with the name X5CrNi18-10 and the number 1.4301 as specified in EN 10088-3 of 50 mm diameter, dimensional tolerances as specified in EURONORM 60, in process route 1D (see Table 6), inspection document 3.1.B as specified in EN 10204:

10 t rounds EURONORM 60 – 50

Steel EN 10088-3 – X5CrNi18-10 + 1D

Inspection document 3.1.B

or

10 t rounds EURONORM 60 – 50

Steel EN 10088-3 – 1.4301 + 1D

Inspection document 3.1.B

7 Classification of grades

Steels covered in this European Standard are classified according to their structure into

- ferritic steels;
- martensitic steels;
- precipitation-hardening steels;
- austenitic steels;

— austenitic-ferritic steels.

See also note to 1.1 and annex B of EN 10088-1.

8 Requirements

8.1 Production process

Unless a special steel-making process is agreed when ordering, the steel-making process for steels conforming to this European Standard shall be at the discretion of the manufacturer.

8.2 Delivery condition

The products shall be supplied in the delivery condition agreed in the order by reference to the process route given in Table 6 and, where different alternatives exist, to the treatment conditions given in Table 7 to Table 11 and Table 17 (see also annex A).

8.3 Chemical composition

8.3.1 The chemical composition requirements given in Table 1 to Table 4 apply in respect of the chemical composition according to the cast analysis.

8.3.2 The product analysis may deviate from the limiting values for the cast analysis given in Table 1 to Table 4 by the values listed in Table 5.

8.4 Chemical corrosion properties

Referring to resistance to intergranular corrosion as defined in EURONORM 114 for ferritic, austenitic and austenitic-ferritic stainless steels, the specifications in Table 7, Table 10 and Table 11 apply.

NOTE 1 EURONORM 114 is not applicable for testing martensitic and precipitation-hardening steels.

NOTE 2 The corrosion resistance of stainless steels is very dependent on the type of environment and can therefore not always be clearly ascertained through laboratory tests. It is therefore advisable to draw on the available experience of the use of the steels.

8.5 Mechanical properties

8.5.1 The mechanical properties at room temperature as specified in Table 7 to Table 11 apply for each specified heat-treatment condition. This does not apply to the process route 1U (hot rolled, not heat treated, not descaled) and to semi-finished products.

If by agreement at the time of ordering the products are to be supplied in a non-heat-treated condition, the mechanical properties specified in Table 7, Table 8, Table 9, Table 10 and Table 11 shall be obtainable from reference test pieces which have received the appropriate heat treatment (simulated heat treatment).

For cold-worked products, the mechanical properties at room temperature as specified in Table 17 apply.

NOTE Austenitic steels are insensitive to brittle fracture in the solution-annealed condition. Because they do not have a pronounced transition temperature, which is characteristic of other steels, they are also useful for application at cryogenic temperatures.

8.5.2 The values in Table 12 to Table 16 apply for the 0,2 % and 1 % proof strength at elevated temperatures.

8.6 Surface quality

Slight surface imperfections, inherent in the production process, are permitted.

If more exact requirements for the surface quality are necessary, these shall be agreed at the time of enquiry and order, where appropriate, on the basis of EN 10221.

8.7 Internal soundness

For the internal soundness, where appropriate, requirements together with the conditions for their verification may be agreed at the time of enquiry and order.

9 Testing

9.1 General

The manufacturer shall carry out appropriate process control, inspection and testing to assure himself that the delivery complies with the requirements of the order.

This includes the following:

- a suitable frequency of verification of the dimensions of the products;
- an adequate intensity of visual examination of the surface quality of the products;
- an appropriate frequency and type of test to ensure that the correct grade of steel is used.

The nature and frequency of these verifications, examinations and tests are determined by the manufacturer, in the light of the degree of consistency that has been determined by the evidence of the quality system. In view of this, verifications by specific tests for these requirements are not necessary unless otherwise agreed.

9.2 Agreement on tests and inspection documents

9.2.1 At the time of ordering, the issue of one of the inspection documents in accordance with EN 10204 may be agreed for each delivery.

9.2.2 If it is agreed to issue a test report **2.2** in accordance with EN 10204 it shall indicate the following information:

- a) the information groups A, B and Z of EURONORM 168;

- b) the results of the cast analysis in accordance with the code numbers C71 to C92 in EURONORM 168.

9.2.3 If the issuing of an inspection certificate 3.1.A, 3.1.B or 3.1.C according to EN 10204 or of an inspection report 3.2 according to EN 10204 has been agreed, specific inspections according to **9.3** are to be carried out and the following information shall be given in the inspection document with the code numbers and details required by EURONORM 168:

- a) } as under **9.2.2** a) and b).
- b) }
- c) the results of the mandatory tests marked in Table 18, second column, by an “m”;
- d) the results of any optional test or inspections agreed when ordering.

9.3 Specific inspection and testing

9.3.1 Extent of testing

The tests to be carried out, either mandatorily (m) or by agreement (o) and the composition and size of the test units, and the number of sample products, samples and test pieces to be taken are given in Table 18.

9.3.2 Selection and preparation of samples

9.3.2.1 The specifications of EURONORM 18 shall be observed in sampling and sample preparation. The stipulations in **9.3.2.2** apply additionally for the mechanical tests.

9.3.2.2 The samples for the tensile test shall be taken in accordance with Figure 1 to Figure 3. If it has been agreed that impact tests shall be carried out, the samples shall be taken from the same location.

The samples shall be taken from products in the delivery condition. If agreed, samples from bars may be taken before straightening. For samples to be given a simulated heat treatment, the conditions for annealing, hardening and tempering shall be agreed.

9.3.2.3 Samples for the hardness test and for the resistance to intergranular corrosion test, where requested, shall be taken from the same locations as those for the mechanical tests.

9.4 Test methods

9.4.1 Unless otherwise agreed when ordering, the choice of a suitable physical or chemical method of analysis to determine the product analysis is at the discretion of the manufacturer. In cases of dispute the analysis shall be carried out by a laboratory approved by the two parties. The method of analysis to be used shall be agreed, where possible with reference to appropriate European Standards or EURONORMS.

9.4.2 The tensile test at room temperature shall be carried out in accordance with EN 10002-1, this generally being with proportional test pieces having a gauge length $L_0 = 5,65 \sqrt{S_0}$ (S_0 = cross-section of the test piece). In cases of doubt and in referee testing these test pieces shall be used.

The tensile strength and elongation after fracture shall be determined and additionally for ferritic, martensitic, precipitation-hardening and austenitic-ferritic steels, the 0,2 % proof strength and for austenitic steels the 0,2 % and 1 % proof strength.

9.4.3 If a tensile test at elevated temperature has been ordered, this shall be carried out in accordance with EN 10002-5. If the proof strength is to be verified, the 0,2 % proof strength shall be determined for ferritic, martensitic, precipitation-hardening and austenitic-ferritic steels. In the case of austenitic steels, the 0,2 % and the 1 % proof strength shall be determined.

9.4.4 If an impact test has been ordered, it shall be carried out in accordance with EN 10045-1 on test pieces with a V-notch. The average obtained from three test pieces is considered to be the test result (see also EN 10021).

9.4.5 The Brinell hardness test shall be carried out in accordance with EN 10003-1.

9.4.6 The resistance to intergranular corrosion shall be tested in accordance with EURONORM 114.

9.4.7 Dimensions and dimensional tolerances of the products shall be tested in accordance with the requirements of the relevant dimensional standards, where available.

9.5 Retests

See EN 10021.

10 Marking

10.1 Marking shall be durable.

10.2 Unless otherwise agreed, the requirements listed in Table 19 apply.

10.3 Unless otherwise agreed, the products shall be marked as follows:

- semi-finished products, bars and sections of thicknesses over 35 mm by inking, adhesive labels, electrolytic etching or stamping;
- bars and sections in thicknesses up to 35 mm by labels attached to the bundle or by means of the possibilities listed against the first dash;
- rods by means of a label attached to the coil.

NOTE If the marking is to be applied by inking or adhesive label, the inks or adhesives should be carefully selected to ensure that resistance to corrosion is not impaired.

Table 1 — Chemical composition (cast analysis)^a of ferritic stainless steels

Steel designation		% by mass										
Name	Number	C max.	Si max.	Mn max.	P max.	S	N max.	Cr	Mo	Ni	Ti	Other
Standard grades												
X2CrNi12	1.4003	0,030	1,00	1,50	0,040	≤ 0,015	0,030	10,50 to 12,50		0,30 to 1,00		
X6Cr13	1.4000	0,08	1,00	1,00	0,040	≤ 0,030 ^b		12,00 to 14,00				
X6Cr17	1.4016	0,08	1,00	1,00	0,040	≤ 0,030 ^b		16,00 to 18,00				
X6CrMoS17	1.4105	0,08	1,50	1,50	0,040	0,15 to 0,35		16,00 to 18,00	0,20 to 0,60			
X6CrMo17-1	1.4113	0,08	1,00	1,00	0,040	≤ 0,030 ^b		16,00 to 18,00	0,90 to 1,40			
Special grade												
X2CrMoTiS18-2 ^c	1.4523 ^c	0,030	1,00	0,50	0,040	0,15 to 0,35		17,50 to 19,00	2,00 to 2,50		0,30 to 0,80	(C + N) ≤ 0,040
^a Elements not quoted in this table may not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel. ^b For products to be machined, a controlled sulfur content of 0,015 % to 0,030 % is recommended. ^c Patented steel grade.												

Table 2 — Chemical composition (cast analysis)^a of martensitic and precipitation-hardening stainless steels

Steel designation		% by mass										
Name	Number	C	Si max.	Mn max.	P max.	S	Cr	Cu	Mo	Nb	Ni	Other
Standard grades (martensitic steels) ^b												
X12Cr13	1.4006	0,08 to 0,15	1,00	1,50	0,040	≤ 0,030 ^c	11,50 to 13,50				≤ 0,75	
X12CrS13	1.4005	0,08 to 0,15	1,00	1,50	0,040	0,15 to 0,35	12,00 to 14,00		≤ 0,60			
X20Cr13	1.4021	0,16 to 0,25	1,00	1,50	0,040	≤ 0,030 ^c	12,00 to 14,00					
X30Cr13	1.4028	0,26 to 0,35	1,00	1,50	0,040	≤ 0,030 ^c	12,00 to 14,00					
X39Cr13	1.4031	0,36 to 0,42	1,00	1,00	0,040	≤ 0,030 ^c	12,50 to 14,50					
X46Cr13	1.4034	0,43 to 0,50	1,00	1,00	0,040	≤ 0,030 ^c	12,50 to 14,50					
X50CrMoV15	1.4116	0,45 to 0,55	1,00	1,00	0,040	≤ 0,030 ^c	14,00 to 15,00		0,50 to 0,80			V: 0,10 to 0,20
X14CrMoS17	1.4104	0,10 to 0,17	1,00	1,50	0,040	0,15 to 0,35	15,50 to 17,50		0,20 to 0,60			
X39CrMo17-1	1.4122	0,33 to 0,45	1,00	1,50	0,040	≤ 0,030 ^c	15,50 to 17,50		0,80 to 1,30		≤ 1,00	
X17CrNi16-2	1.4057	0,12 to 0,22	1,00	1,50	0,040	≤ 0,030 ^c	15,00 to 17,00				1,50 to 2,50	
X3CrNiMo13-4	1.4313	≤ 0,05	0,70	1,50	0,040	≤ 0,015	12,00 to 14,00		0,30 to 0,70		3,50 to 4,50	N: ≥ 0,020
X4CrNiMo16-5-1	1.4418	≤ 0,06	0,70	1,50	0,040	≤ 0,030 ^c	15,00 to 17,00		0,80 to 1,50		4,00 to 6,00	N: ≥ 0,020

Table 2 — Chemical composition (cast analysis)^a of martensitic and precipitation-hardening stainless steels

Steel designation		% by mass										
Name	Number	C	Si max.	Mn max.	P max.	S	Cr	Cu	Mo	Nb	Ni	Other
Standard grades (precipitation-hardening steels)												
X5CrNiCuNb16-4	1.4542	≤ 0,07	0,70	1,50	0,040	≤ 0,030 ^c	15,00 to 17,00	3,00 to 5,00	≤ 0,60	5 × C to 0,45	3,00 to 5,00	Al: 0,70 to 1,50
X7CrNiAl17-7	1.4568	≤ 0,09	0,70	1,00	0,040	≤ 0,015	16,00 to 18,00				6,50 to 7,80 ^d	
X5CrNiMoCuNb14-5	1.4594	≤ 0,07	0,70	1,00	0,040	≤ 0,015	13,00 to 15,00	1,20 to 2,00	1,20 to 2,00	0,15 to 0,60	5,00 to 6,00	
Special grades (martensitic steels) ^b												
X29CrS13	1.4029	0,25 to 0,32	1,00	1,50	0,040	0,15 to 0,25	12,00 to 13,50		≤ 0,60			V: 0,07 to 0,12
X70CrMo15	1.4109	0,65 to 0,75	0,70	1,00	0,040	≤ 0,030 ^c	14,00 to 16,00		0,40 to 0,80			
X105CrMo17	1.4125	0,95 to 1,20	1,00	1,00	0,040	≤ 0,030 ^c	16,00 to 18,00		0,40 to 0,80			
X90CrMoV18	1.4112	0,85 to 0,95	1,00	1,00	0,040	≤ 0,030 ^c	17,00 to 19,00		0,90 to 1,30			
^a Elements not quoted in this table may not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel. ^b Tighter carbon ranges may be agreed at the time of enquiry and order. ^c For products to be machined, a controlled sulfur content of 0,015 % to 0,030 % is recommended. ^d For better cold deformability, the upper limit may be increased to 8,30 %.												