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Hot rolled products made from weldable, fine grain structural steel

Technical delivery conditions for thermomechanically rolled steel
English version of DIN EN 10113 Part 3

DIN EN 10113 Part 3

Warmgewalzte Erzeugnisse aus schweißgeeigneten Feinkornbaustählen;
Lieferbedingungen für thermomechanisch gewalzte Stähle

European Standard EN 10113-3 : 1993 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

This standard has been prepared by ECISS/TC 10.

The responsible German body involved in its preparation was the *Normenausschuß Eisen und Stahl* (Steel and Iron Standards Committee), Technical Committee *Stähle für den Stahlbau.*

DIN EN 10113 is divided into three Parts. Part 1 specifies general technical delivery conditions for hot rolled products made from weldable fine grain steel. Part 2 gives more specific requirements for such steel in the normalized condition, and the present standard, for thermomechanically rolled steel.

Up to now, a DIN Standard has not existed for such products. Instead, these were covered in the *Stahl-Eisen-Werkstoffblätter* (Iron and steel materials sheets) 083 and 084, covering plate, sheet, strip and wide flats, and sections and bars of profiled cross section, respectively, issued by the *Verein Deutscher Eisenhüttenleute* (Society of German Ferrous Metallurgists).

Standards referred to

(and not included in **Normative references**)

DIN EN 10113 Part 1 Hot rolled products made from weldable, fine grain structural steel; general technical delivery conditions

DIN EN 10113 Part 2 Hot rolled products made from weldable, fine grain structural steel; technical delivery conditions for normalized rolled steel

International Patent Classification

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Continued overleaf.
EN comprises 6 pages.

Editor's note

*This standard reproduces the official text of the English version of EN 10113-3 as issued by CEN. In its preparation for publication as DIN EN 10113 Part 3 (English version), certain points have been noted which we consider to be in need of correction. These have been marked *). The suggested amendments are given below and will be forwarded to the responsible CEN Secretariat for its consideration.*

In presentation, orthography, punctuation and hyphenation, the aim has been to implement the PNE Rules consistently. Obvious errors (e.g. redundancies and omissions) have been rectified without further reference.

Suggested amendments

1 *For the sake of clarity, clause 1 should be amended to read: 'This European Standard, in conjunction with Part 1, specifies technical delivery conditions for flat and long products made from hot rolled, weldable, fine grain structural steel supplied in the thermomechanically rolled condition. Table 1 specifies the chemical composition of such steel, and tables 3, 4 and 5 specify their mechanical properties. Flat products made from such steel are supplied in nominal thicknesses ≤ 63 mm and long products, in nominal thicknesses ≤ 150 mm. The option numbers given in various subclauses refer to the optional requirements defined in Part 1 of this European Standard.'*

2 *The last sentence of subclause 4.2 does not reflect the German text, which translates: 'In the event ... options, the material shall be supplied in accordance with the general requirements specified here.'*

3 *For the purpose of elaboration, the example given in subclause 6.2 should be amended to read: 'Steel (S) in the thermomechanically rolled condition (M) in compliance with this standard, with a specified minimum yield strength at ambient temperature of 355 N/mm² (355) and a specified minimum value of impact energy at −50°C (L) shall be designated ...'.*

4 *The heading of subclause 7.5.2.2.1 does not reflect the German text, which translates as 'Suitability for cold bending, chamfering and cold flanging'. Likewise, the term 'flanging' as used in the text to that subclause should be replaced by the above terms.*

5 *To avoid confusion, the heading of subclause 8.2 should read: 'Test batch', and the text: 'The test batch shall be in accordance with EN 10113-1.'*

6 *For the sake of comprehension, the first paragraph of subclause 8.3.2 should be amended to read: 'It may be specified at the time of ordering that the parent plate or coil for flat products either be tested for impact energy only, or be tested for both impact energy and tensile strength.'*

EUROPEAN STANDARD
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Descriptors: Iron and steel products, hot rolled products, structural steels, welded construction, hot rolling, delivery, designation, quality classes, chemical composition, grades, quality, mechanical properties, inspection, tests.

English version

Hot-rolled products in weldable, fine grain structural steels

Part 3: Delivery conditions for thermomechanical rolled steels

Produits laminés à chaud en aciers de construction soudable à grains fins.
Partie 3: Conditions de livraison des aciers obtenus par laminage thermomécanique

Warmgewalzte Erzeugnisse aus schweißgeeigneten Feinkornbaustählen.
Teil 3: Lieferbedingungen für thermomechanisch gewalzte Stähle

This European Standard was approved by CEN on 1993-03-05.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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

CEN

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 drawn up by ECISS/TC 10 'Structural steel; quality standards' the Secretariat of which is held by NNI.

Technical Committee ECISS/TC 10 met in June 1991 in Brussels and agreed to submit the text to Formal Vote. The result was positive. The following countries were represented at that meeting: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Luxembourg, Netherlands, Spain, Sweden and UK.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, and conflicting national standards withdrawn, by September 1993 at the latest.

In accordance with 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 and United Kingdom.

1 Scope

Part 3 of this European Standard, in addition to Part 1, specifies requirements for flat products with nominal thickness ≤63 mm and long products with nominal thickness ≤150 mm of hot-rolled weldable fine grain structural steel in the thermomechanical rolled condition in the grades and qualities given in table 1 (chemical composition) and tables 3, 4 and 5 (mechanical properties).*)

2 Normative references

The normative references listed in EN 10113-1 shall apply.

3 Definitions

The definitions given in EN 10113-1 shall apply.

4 Information to be supplied by the purchaser

4.1 General

The following information shall be supplied by the purchaser at the time of ordering:

a) details of the product form and relevant quantities;

b) reference to this European Standard;

c) nominal dimensions and tolerances (see 5.1);

d) the grade and quality of the steel (see tables 1 to 5);

e) the type of inspection document (see 8.8).

Where no specifications are made, the supplier shall consult with the purchaser.

4.2 Options

A number of options is specified in clause 11. In the event that the purchaser does not indicate his wish to implement any of these options, the supplier shall supply in accordance with the basic specification.*)

5 Dimensions, tolerances and mass

5.1 Dimensions and tolerances

The dimensions and tolerances shall be in accordance with the relevant European Standards and EURONORMs (see 2.2 of EN 10113-1).

5.2 Mass

The mass of steel shall comply with EN 10113-1.

6 Classification into grades and designation

6.1 Classification into grades

The steel grades S275 and S355 are classified as unalloyed quality steels, and the steel grades S420 and S460, as alloy special steels, in EN 10020.

6.2 Designation

The designation shall be in accordance with EN 10 113-1.

EXAMPLE:

Thermomechanical rolled steel with a specified minimum yield strength at ambient temperature of 355 N/mm², and with a specified minimum impact value at −50 °C:*)

Steel EN 10 113-3 – S355ML

7 Technical requirements

7.1 Steelmaking process

The steelmaking process shall be in accordance with EN 10 113-1.

Option 1.

7.2 As delivered condition

The products shall be supplied in the thermomechanically rolled condition as defined in clause 3.

7.3 Chemical composition

7.3.1 The chemical composition, as determined by ladle analysis, shall comply with the values specified in table 1.

7.3.2 Table 1 of EN 10 113-1 shall apply for the limit deviations for the product analysis from the limiting values specified for the ladle analysis. The manufacturer shall, at the time of ordering, inform the purchaser of any alloying elements which will be deliberately added to the material to be supplied.

7.3.3 If agreed at the time of ordering, a maximum value of carbon equivalent (*CEV*), in accordance with table 2, shall apply.

Option 2.

NOTE: As a result of the lower carbon content and of the value of carbon equivalent, material supplied in condition M has improved weldability.

7.4 Mechanical properties

7.4.1 General

When tested in accordance with clause 8, in the as delivered condition specified in 7.2, the values of mechanical properties shall be as specified in tables 3, 4 and 5.

7.4.2 Impact energy

Determination of impact energy shall be carried out in accordance with EN 10 113-1.

Option 4.

Option 5.

7.5 Technological properties

7.5.1 Weldability

Weldability shall be in accordance with EN 10 113-1.

7.5.2 Formability

NOTE: Recommendations regarding cold forming are laid down in EU IC 2.

7.5.2.1 Hot forming

Hot forming shall not be carried out.

NOTE: Products supplied in the thermomechanically rolled condition are not suitable for hot forming.

7.5.2.2 Cold forming

7.5.2.2.1 Flangeability*)

If specified at the time of ordering, plate, sheet, strip and wide flats with a nominal thickness ≤12 mm shall be suitable for flanging,*) without cracking, with the following minimum bend radii:

- twice the nominal thickness with the bend axis in the transverse direction, and 2,5 times the nominal thickness with the bend axis in the longitudinal direction, for steel grades S275 and S355;
- four times the nominal thickness with the bend axis in the transverse direction, and five times the nominal thickness with the bend axis in the longitudinal direction, for steel grades S420 and S460.

Option 11.

7.5.2.2.2 Roll forming

If specified at the time of ordering, plate and strip with a nominal thickness ≤8 mm shall be suitable for the production of sections by means of cold forming (e.g. in accordance with EURONORM 162), with the minimum bend radii specified in 7.5.2.2.1.

Option 12.

NOTE: Steel grades that are suitable for roll forming are also suitable for the production of cold formed square and rectangular hollow sections.

7.5.3 Other requirements

7.5.3.1 If specified at the time of ordering, grades S275 and S355 shall be suitable for hot-dip galvanizing and shall comply with the relevant product quality requirements.

Option 7.

7.5.3.2 If agreed at the time of ordering, heavy sections shall be suitable for slitting.

Option 15.

7.6 Surface condition

The surface condition shall be in accordance with EN 10 113-1.

Option 8.

7.7 Internal defects

The specifications given in EN 10 113-1 regarding internal defects shall be complied with.

Option 13 (for flat products).

Option 16 (for long products).

8 Testing and inspection

8.1 General

The specifications of 8.1 of EN 10 113-1 shall be complied with.

Option 9.

8.2 Sampling*)

Sampling shall be in accordance with EN 10 113-1.*)

8.3 Test unit

8.3.1 A test unit shall consist of products of the same form and grade and be within the same thickness range specified in table 3.

For verifying the mechanical properties, the test unit shall have a mass of 40 t or less.

8.3.2 If specified at the time of ordering, for flat products the impact test only or the impact test and the tensile test shall be carried out on each parent plate or coil.*)

Options 19a and 19b.

8.4 Determination of chemical composition

Determination of the chemical composition shall be in accordance with EN 10113-1.

Option 3.

8.5 Mechanical tests

The requirements for mechanical tests specified in EN 10113-1 shall be complied with.

8.6 Test methods

The test methods specified in EN 10113-1 shall be complied with.

8.7 Retests and resubmission for testing

The requirements for retests and resubmission for testing specified in EN 10113-1 shall be complied with.

8.8 Inspection documents

The requirements for inspection documents specified in EN 10113-1 shall be complied with.

9 Marking

The marking of flat and long products shall be as specified in EN 10113-1.

Option 10.

10 Complaints

The specifications regarding complaints given in EN 10113-1 shall apply.

11 Options

11.1 All products

See options 1 to 10 in EN 10113-1.

18) Whether a maximum S content of 0,007 % is required for products having a thickness ≤16 mm (see table 1), intended to be used in railway applications.

11.2 Flat products

See options 11 to 14 in EN 10113-1.

19a) Whether impact testing only is to be carried out on each parent plate or coil (see 8.3.2).

19b) Whether both impact testing and tensile testing are to be carried out on each parent plate or coil (see 8.3.2).

11.3 Long products

See options 15 and 16 in EN 10113-1.

20) Whether minimum values of mechanical properties are to be specified for long products supplied in thicknesses >150 mm, or for flat products supplied in thicknesses >63 mm (see tables 3, 4 and 5).

Table 1: Steel grades and their chemical composition as determined by ladle analysis

Designation		Percentage by mass											
Symbol as in EN 10027-1 and ECISS IC 10	Material number as in EN 10027-2	C max.	Si max.	Mn max.	P max.	S max.[1]	Nb max.	V max.	Al_{total} min.[2]	Ti max.	Mo[3] max.	Ni max.	N max.
S275M	1.8818	0,13[4]	0,50	1,50	0,035	0,030	0,05	0,08	0,02	0,05	0,20	0,30	0,015
S275ML	1.8819				0,030	0,025							
S355M	1.8823	0,14[4]	0,50	1,60	0,035	0,030	0,05	0,10	0,02	0,05	0,20	0,30	0,015
S355ML	1.8834				0,030	0,025							
S420M	1.8825	0,16[5]	0,50	1,70	0,035	0,030	0,05	0,12	0,02	0,05	0,20	0,30[6]	0,020
S420ML	1.8836				0,030	0,025							
S460M	1.8827	0,16[5]	0,60	1,70	0,035	0,030	0,05	0,12	0,02	0,05	0,20	0,45[7]	0,025
S460ML	1.8838				0,030	0,025							

[1]) For railway applications, a maximum S content of 0,007 % may be agreed at the time of ordering, for all products with a thickness ≤16 mm.
Option 18.

[2]) If sufficient nitrogen-binding elements are present, the minimum total Al content need not apply.

[3]) The total sum of Cr, Cu and Mo shall be not higher than 0,60 %.

[4]) For long products, a maximum C content of 0,15 % for grade S275, or 0,16 % for grade S355, applies.

[5]) For long products of grades S420 and S460, a maximum C content of 0,18 % applies.

[6]) For long products of grade S420, a maximum Ni content of 0,60 % applies.

[7]) For long products of grade S460, a maximum Ni content of 0,70 % applies.

Table 2: Maximum carbon equivalent based on ladle analysis for M steels
(if agreed at the time of ordering)
Option 2

Designation		Maximum carbon equivalent, in %, for a nominal product thickness, in mm, of			
Symbol as in EN 10027-1 and ECISS IC 10	Material number as in EN 10027-2	≤16	>16 ≤40	>40 ≤63	>63 ≤150[1])
S275M S275ML	1.8818 1.8819	0,34	0,34	0,35	0,38
S355M S355ML	1.8823 1.8834	0,39	0,39	0,40	0,45
S420M S420ML	1.8825 1.8836	0,43	0,45	—	—
S460M S460ML	1.8827 1.8838	0,45	0,46	—	—

[1]) The values apply for long products only.

Table 3: Mechanical properties at ambient temperature for thermomechanically rolled steel

Designation		Mechanical properties[1])				
		Tensile strength, R_m	Upper yield strength, R_{eH}, for a nominal product thickness, in mm, of			Elongation at fracture[2])
Symbol as in EN 10027-1 and ECISS IC 10	Material number as in EN 10027-2		≤16	>16 ≤40	>40 ≥63[3])	($L_0=5{,}65\sqrt{S_0}$)
		N/mm²	N/mm² min.			% min.
S275M S275ML	1.8818 1.8819	360 to 510	275	265	255	24
S355M S355ML	1.8823 1.8834	450 to 610	355	345	335	22
S420M S420ML	1.8825 1.8836	500 to 660	420	400	390	19
S460M S460ML	1.8827 1.8838	530 to 720	460	440	430	17

[1]) For long products in thicknesses >150 mm and for flat products in thicknesses >63 mm, the values shall be the subject of agreement at the time of ordering.
Option 20.

[2]) For product thicknesses <3 mm for which test pieces with an original gauge length, L_0, of 80 mm are to be tested, the values shall be the subject of agreement at the time of ordering.

[3]) For long products, the values specified for thicknesses ≤150 mm shall apply.

Table 4: Minimum values of impact energy as determined on longitudinal V-notch test pieces

Designation		Minimum values of impact energy, in J[1]), at test temperatures, in °C, of						
Symbol as in EN 10027-1 and ECISS IC 10	Material number as in EN 10027-2	+20	0	−10	−20	−30	−40	−50
S275M S355M S420M S460M	1.8818 1.8823 1.8825 1.8827	55	47	43	40	—	—	—
S275ML S355ML S420ML S460ML	1.8819 1.8834 1.8836 1.8838	63	55	51	47	40	31	27

[1]) For long products in thicknesses >150 mm and for flat products in thicknesses >63 mm, the values shall be the subject of agreement at the time of ordering.
Option 20.

Table 5: Minimum values of impact energy as determined on transverse V-notch test pieces (if agreed at the time of ordering)
Option 5

Designation		Minimum values of impact energy, in J[1]), at test temperatures, in °C, of						
Symbol as in EN 10027-1 and ECISS IC 10	Material number as in EN 10027-2	+20	0	−10	−20	−30	−40	−50
S275M S355M S420M S460M	1.8818 1.8823 1.8825 1.8827	31	27	24	20	—	—	—
S275ML S355ML S420ML S460ML	1.8819 1.8834 1.8836 1.8838	40	34	30	27	23	20	16

[1]) For long products in thicknesses >150 mm and for flat products in thicknesses >63 mm, the values shall be the subject of agreement at the time of ordering.
Option 20.