BRITISH STANDARD

BS EN
10113-3 : 1993

Hot-rolled products in weldable fine grain structural steels

Part 3. Delivery conditions for thermomechanical rolled steels

The European Standard EN 10113-3 : 1993 has the status of a British Standard

Produits lamine´s a` chaud en aciers de construction soudable a` grains fins
Partie 3. Conditions de livraison des aciers obtenus par laminage thermome´chaniques

Warmgewalzte Erzeugnisse aus schweissgeeigneten Feinkornbausta¨hlen
Teil 3. Lieferbedingungen fu¨r thermomechanisch gewalzte Sta¨hle

UDC 669.14.018.62-122.4-4 : 620.1

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This British Standard, having been prepared under the direction of the Iron and Steel Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 September 1993

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Contents

National foreword

This British Standard has been prepared under the direction of the Iron and Steel Standards Policy Committee and is the English language version of EN 10113-3 : 1993 *Hot rolled products in weldable fine grain structural steels Part 3 : Delivery conditions for thermomechanical rolled steels*, published by the European Committee for Standardization (CEN).

Together with BS EN 10113-1, BS EN 10113-2 and BS EN 10155, it partially supersedes BS 4360 : 1990 which will be withdrawn in due course.

The other Parts of BS EN 10113 are as follows:

BS EN 10113-1	*Hot rolled products in weldable fine grain structural steels Part 1 : General delivery conditions*
BS EN 10113-2	*Hot rolled products in weldable fine grain structural steels Part 2 : Delivery conditions for normalized/normalized rolled steels*

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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 lamine´s a` chaud end aciers de construction soudable a` grains fins
Partie 3: Conditions de livraison des aciers obtenus per laminage thermome´chaniques

Warmgewalzte Erzeugnisse aus schweissgeeigneten Feinkornbausta¨hlen
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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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CEN

European Committee for Standardization
Comite´ Europe´en de Normalisation
Europa¨isches Komitee fu¨r Normung

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

Foreword

This European Standard has been drawn up by ECISS/TC 10 'Structural steel — qualities' whose Secretariat is held by NNI.

The Technical Committee ECISS/TC 10 met in June 1991 in Brussels and agreed on the text for circulation for formal vote within CEN. The following countries were represented in 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, at the latest by September 1993, and conflicting national standards shall be withdrawn at the latest by September 1993.

This European Standard has been adopted and in accordance with the CEN/CENELEC Rules, 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.

Contents

1 Scope

Part 3 of this European Standard, in addition to Part 1, specifies requirements for flat products with nominal thickness $\leq$ 63 mm and long products with nominal thickness $\leq$ 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 as given in EN 10113 Part 1 shall apply.

3 Definitions

The definitions given in EN 10113 Part 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 enquiry and order:

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 specific choice is made by the purchaser concerning points a), b), c), d) and e) the supplier shall refer back to 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, mass and tolerances

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 Part 1).

5.2 Mass of steel

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

6 Classification of qualities; designation

6.1 Classification of qualities

The steel grades S275 and S355 of Part3 of this European Standard are non-alloy quality steels and the steel grades S420 and S460 of Part 3 of this European Standard are alloy special steels according to EN 10020.

6.2 Designation

The designation shall be in accordance with EN 10113 Part 1.

Example: Thermomechanical rolled steel with a specified minimum yield strength at ambient temperature of 355 N/mm^2, and with a specified minimum impact value at -50 °C:

Steel EN 10113-3 S355ML

7 Technical requirements

7.1 Steel manufacturing process

The steel manufacturing process shall be in accordance with EN 10113 Part 1.

Option 1.

7.2 Delivery condition

The products shall be supplied in the thermomechanical rolled condition obtained as defined in clause **3**.

7.3 Chemical composition

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

7.3.2 The values for permissible deviations of the product analysis from the specified limits of the ladle analysis are as specified in table 1 of EN 10113 Part 1. The manufacturer shall inform the purchaser at the time of the enquiry and order which of the alloying elements appropriate to the steel grade required will be deliberately added to the material to be delivered.

7.3.3 If agreed at the time of the enquiry and order the maximum carbon equivalent values, based on the ladle analysis, given in table 2 shall apply.

Option 2.

NOTE. As a consequence of the lower carbon content and carbon equivalent values the material in the delivery condition M has improved weldability properties.

7.4 Mechanical properties

7.4.1 *General*

Under the inspection and testing conditions as specified in clause **8** and in the delivery condition as specified in **7.2** the mechanical properties shall comply with the values given in tables 3, 4 and 5.

7.4.2 ***Impact test***

The verification of the impact energy value shall be carried out in accordance with EN 10113 Part 1.

Option 4.

Option 5.

7.5 Technological properties

7.5.1 ***Weldability***

Weldability shall be in accordance with EN 10113 Part 1.

7.5.2 ***Formability***

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

7.5.2.1 *Hot forming*

Hot forming shall not be undertaken.

NOTE. The products ordered and supplied in the thermomechanical 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 the enquiry and order plate, sheet, strip and wide flats ordered and supplied in the thermomechanical rolled condition with a nominal thickness $\leq$ 12 mm shall be suitable for flanging without cracking with the following minimum bend radii:

— 2 times the nominal thickness with the axis of the bend in transverse direction and 2,5 times the nominal thickness in longitudinal direction for the steel grades S275 and S355;

— 4 times the nominal thickness with the axis of the bend in transverse direction and 5 times the nominal thickness in longitudinal direction for the steel grades S420 and S460.

Option 11.

7.5.2.2.2 *Roll forming*

If specified at the time of the enquiry and order plate and strip with a nominal thickness $\leq$ 8 mm shall be suitable for the production of sections through cold rolling (for example according to EURONORM 162), with the same minimum bend radii as given in **7.5.2.2.1.**

Option 12.

NOTE. The products suitable for roll forming are also suitable for the manufacture of cold-finished square and rectangular hollow sections.

7.5.3 ***Other requirements***

7.5.3.1 If specified at the time of the enquiry and order the grades S275 and S355 shall be suitable for hot-dip zinc coating and shall comply with the relevant product quality requirements.

Option 7.

7.5.3.2 If agreed at the time of the enquiry and order the material shall be suitable for slitting of heavy sections.

Option 15.

7.6 Surface finish

The surface finish shall be in accordance with EN 10113 Part 1.

Option 8.

7.7 Internal defects

The internal defects shall be in accordance with EN 10113 Part 1.

Option 13 (for flat products).

Option 16 (for long products).

8 Inspection and testing

8.1 General

The products shall be supplied in accordance with **8.1** of EN 10113 Part 1.

Option 9.

8.2 Sampling

Sampling shall be in accordance with EN 10113 Part 1.

8.3 Test units

8.3.1 The test unit shall contain products of the same form and grade and of the same thickness range as specified in table 3 for the yield strength. For verifying the mechanical properties the following test unit shall apply:

— 40 t or part thereof.

8.3.2 If specified at the time of the enquiry and order 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.

Option 19a and 19b.

8.4 Verification of chemical composition

The verification of the chemical composition shall be in accordance with EN 10113 Part 1.

Option 3.

8.5 Mechanical tests

The mechanical tests shall be in accordance with EN 10113 Part 1.

8.6 Test methods

The test methods shall be in accordance with EN 10113 Part 1.

8.7 Retests and resubmission for testing

The retests and resubmission for testing shall be in accordance with EN 10113 Part 1.

8.8 Inspection documents

The inspection documents shall comply with EN 10113 Part 1.

9 Marking for flat and long products

The marking for flat and long products shall comply with EN 10113 Part 1.

Option 10.

10 Complaints after delivery

The complaints after delivery shall be in accordance with EN 10113 Part 1.

11 Options

11.1 All products

See options 1 to 10 of EN 10113 Part 1.

18) Whether for railway applications a maximum S content of 0,007 % is required for products with thickness ≤ 16 mm (see table 1).

11.2 Flat products

See options 11 to 14 of EN 10113 Part 1.

19a) Whether the impact test should be carried out on each parent plate or coil (see **8.3.2**).

19b) Whether the impact test and the tensile test should be carried out on each parent plate or coil (see **8.3.2**).

11.3 Long products

See options 15 to 16 of EN 10113 Part 1.

20) Whether for thermomechanical rolled long products of thickness > 150 mm and for flat products of thickness > 63 mm minimum values for mechanical properties are required (see tables 3, 4 and 5).

Table 1. Chemical composition of the ladle analysis for M steels

Designation		C max. %	Si max. %	Mn max. %	P max. %	S max.[1] %	Nb max. %	V max. %	Al total min.[2] %	Ti max. %	Mo max.[3] %	Ni max. %	N max. %
According EN 10027-1 and ECISS IC 10	According EN 10027-2												
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 enquiry and order for all products with a thickness ≤ 16 mm.
Option 18.

[2] If sufficient N-binding elements are present the minimum total Al content does 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 and a maximum C content of 0,16 % for grade S355 applies.

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

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

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

Table 2. Maximum CEV based on the ladle analysis for M steels, if agreed at the time of the enquiry and order
Option 2.

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

[1] The figures apply only for long products.

Table 3. Mechanical properties at ambient temperature for M steels

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

[1] For long products of thickness > 150 mm and for flat products of thickness > 63 mm the values shall be agreed at the time of the enquiry and order.
Option 20 (part 3).

[2] For product thickness < 3 mm for which test pieces with a gauge length of $L_o = 80$ mm shall be tested, the values shall be agreed at the time of the enquiry and order.

[3] For long products of thickness ≤ 150 mm apply.

Table 4. Minimum values of impact energy for impact tests on longitudinal V-notch test pieces for M steels

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

[1] For long products of thickness > 150 mm and for flat products > 63 mm the values shall be agreed at the time of the enquiry and order.
Option 20 (part 3).

Table 5. Minimum values of impact energy for impact tests on longitudinal V-notch test pieces for M steels, when the impact test on transverse test pieces is agreed at the time of the enquiry and order
Option 5.

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

[1)] For long products of thickness > 150 mm and for flat products > 63 mm the values shall be agreed at the time of the enquiry and order.
Option 20 (part 3).

National annex NA (informative)

Committees responsible

The United Kingdom participation in the preparation of this European Standard was entrusted by the Iron and Steel Standards Policy Committee (ISM/-) to Technical Committee ISM/12 upon which the following bodies were represented:

BEAMA Ltd.
British Constructional Steelwork Association Ltd.
British Railways Board
British Steel Industry
Department of Transport
Institution of Structural Engineers
Lloyd's Register of Shipping
National Association of Steel Stockholders
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