BS EN 10149-2:2013

BSI Standards Publication

Hot rolled flat products made of high yield strength steels for cold forming

Part 2: Technical delivery conditions for thermomechanically rolled steels

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National foreword

This British Standard is the UK implementation of EN 10149-2:2013. It supersedes BS EN 10149-2:1996 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/103, Structural Steels Other Than Reinforcements.

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

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Hot rolled flat products made of high yield strength steels for cold forming - Part 2: Technical delivery conditions for thermomechanically rolled steels

Produits plats laminés à chaud en aciers à haute limite d'élasticité pour formage à froid - Partie 2: Conditions techniques de livraison des aciers obtenus par laminage thermomécanique

Warmgewalzte Flacherzeugnisse aus Stählen mit hoher Streckgrenze zum Kaltumformen - Teil 2: Technische Lieferbedingungen für thermomechanisch gewalzte Stähle

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Foreword

This document (EN 10149-2:2013) has been prepared by Technical Committee ECISS/TC 103 “Structural steel other than reinforcements”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by March 2014, and conflicting national standards shall be withdrawn at the latest by March 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 10149-2:1995.

In comparison with EN 10149-2:1995, the following significant technical changes were made:

— Scope was modified;

— subclause 6.1 was revised;

— subclause 7.4.1 was modified;

— subclause 7.5.3 was completely revised;

— Option 13) was added in Clause 11;

— steel grades S900MC and S960MC were added in Tables 1, 2 and B.1;

— footnotes f and g were added in Table 2.

The titles of the other Parts of this European Standard are:

— *Part 1: General technical delivery conditions*;

— *Part 3: Technical delivery conditions for normalized or normalized rolled steels*.

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1 Scope

This European Standard, in addition to EN 10149-1, specifies requirements for flat products made of weldable, hot-rolled, high yield strength steels for cold forming.

The grades are given in Table 1 (chemical composition) and Table 2 (mechanical properties) and are supplied in the thermomechanically rolled delivery condition as given in 7.2.

The steels specified in this European Standard are applicable to hot-rolled flat products in the thickness range of:

— 1,5 mm to 20 mm for the steels which have a specified minimum yield strength of 315 MPa[1)] up to and including 460 MPa[1)];

— 1,5 mm to 16 mm for the steels which have a specified minimum yield strength of 500 MPa[1)] up to and including 700 MPa[1)]; and

— from 2 mm up to 10 mm for the steels with a minimum yield stress in the range from 900 MPa[1)] to 960 MPa[1)].

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 10029, *Hot-rolled plates 3 mm thick or above - Tolerances on dimensions and shape*

EN 10051, *Continuously hot-rolled strip and plate/sheet cut from wide strip of non-alloy and alloy steels - Tolerances on dimensions and shape*

EN 10149-1:2013*, Hot rolled flat products made of high yield strength steels for cold forming - Part 1: General technical delivery conditions*

EN ISO 14713-2:2009, *Zinc coatings - Guidelines and recommendations for the protection against corrosion of iron and steel in structures - Part 2: Hot dip galvanizing (ISO 14713-2:2009)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10149-1:2013 apply.

4 Information to be supplied by the purchaser

4.1 General

The information to be supplied by the purchaser shall be in accordance with EN 10149-1.

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1) 1 MPa = 1 N/mm^2.

4.2 Options

The options given in EN 10149-1 and Clause 11 shall apply.

5 Dimensions, mass and tolerances

5.1 Dimensions and tolerances

The dimensions and tolerances shall be in accordance with EN 10149-1.

For hot rolled plate tolerances, the basic requirements shall be in accordance with EN 10029, including thickness tolerances to class A, unless otherwise agreed at the time of the order.

For plates cut from continuously hot rolled strip, the thickness tolerances shall be in accordance with EN 10051.

5.2 Mass of steel

The calculated mass of steel shall be determined in accordance with EN 10149-1.

6 Classification and designation

6.1 Classification

The steel grades S315MC, S355MC, S420MC, S460MC, S500MC and S550MC of this European Standard are alloy quality steels and the steel grades S600MC, S650MC, S700MC, S900MC and S960MC of this European Standard are alloy special steels according to EN 10020.

6.2 Designation

The designation shall comply with EN 10149-1.

7 Technical requirements

7.1 Steel manufacturing process

The steel manufacturing process shall be in accordance with EN 10149-1.

See EN 10149-1:2013, Clause 11, option 1).

7.2 Delivery condition

The products shall be supplied in the thermomechanically rolled delivery condition.

The surface protection of descaled products shall be in accordance with EN 10149-1.

See EN 10149-1:2013, Clause 11, option 2).

7.3 Chemical composition

The requirements of EN 10149-1 shall apply.

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

See EN 10149-1:2013, Clause 11, option 3).

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 Table 2.

Heating of grades S900MC and S960MC above 400 °C is not recommended. If the purchaser intends to heat grades S900MC and S960MC at temperatures above 400 °C, the mechanical properties after such heating should be agreed at the time of order.

See EN 10149-1:2013, Clause 11, option 13).

7.4.2 Impact energy

If agreed at the time of the order, the verification of the impact energy value shall be carried out in accordance with EN 10149-1.

See EN 10149-1:2013, Clause 11, option 5).

7.5 Technological properties

7.5.1 Weldability

Weldability shall be in accordance with EN 10149-1.

7.5.2 Formability

7.5.2.1 General

NOTE Recommendations regarding cold forming are laid down in CEN/TR 10347. The products supplied according to this standard are not suitable for hot forming.

7.5.2.2 Cold forming

7.5.2.2.1 General

Annex B contains indicative values for the inside bend radii for cold forming.

7.5.2.2.2 Flangeability

The products are suitable for flanging without cracking.

7.5.2.2.3 Roll forming

The suitability for roll forming shall be in accordance with EN 10149-1.

See EN 10149-1:2013, Clause 11, option 6).

7.5.3 Hot-dip zinc-coating

For grades S315MC to S700MC, requirements for chemical composition of steels to be hot-dip zinc coated shall be separately agreed between manufacturer and purchaser.

EN ISO 1461 should be used to specify coating requirements. EN ISO 14713-2 provides further guidance, including information on the influence of various factors, including steel chemical composition, on the coating formation.

Option 7) (see EN 10149-1:2013, Clause 11) can be used to order steels with a chemical composition required for hot-dip zinc coating. When option 7) is implemented, the purchaser and manufacturer shall agree with a steel composition (ladle analysis) of silicon and phosphorous according to either Category A (or steels satisfying the formula Si ≤ 0,03 % and Si+2.5P ≤ 0,09 %) or Category B (limited to 0,14 % < Si ≤ 0,25 %) or Category D (limited to 0,25 % < Si ≤ 0,35 %) with required values as cited by the ranges given in EN ISO 14713-2:2009, Table 1, column 2.

NOTE EN ISO 14713-2:2009, Table 1, gives guidance on typical coating characteristics associated with certain steel compositions on the basis of the surface composition of silicon and phosphorous.

In some cases, steels above S460 may be sensitive to cracking during galvanizing and therefore special care should be taken.

7.6 Surface finish

The surface finish shall be in accordance with EN 10149-1.

See EN 10149-1:2013, Clause 11, option 8).

7.7 Internal soundness

The internal soundness shall be in accordance with EN 10149-1.

See EN 10149-1:2013, Clause 11, option 9).

8 Inspection and testing

8.1 General

The products shall be supplied in accordance with EN 10149-1:2013, 8.1.

See EN 10149-1:2013, Clause 11, option 10).

8.2 Sampling

Sampling shall be in accordance with EN 10149-1.

8.3 Test units

The test unit shall be in accordance with EN 10149-1.

8.4 Verification of chemical composition

The verification of the chemical composition shall be in accordance with EN 10149-1.

See EN 10149-1:2013, Clause 11, option 4).

8.5 Preparation of samples and test pieces

8.5.1 General

The preparation of samples and test pieces shall be in accordance with EN 10149-1.

8.5.2 Preparation of samples

The following samples shall be taken from one sample product of each test unit:

— one sample in the longitudinal direction for tensile testing;

— one sample in the transverse direction for the bend test;

— one sample sufficient for one set of six impact test pieces (if an impact test is agreed at the time of the order, see EN 10149-1:2013, 7.4.2.1).

See EN 10149-1:2013, Clause 11, option 5).

See Annex A.

8.6 Test methods

The test methods shall be in accordance with EN 10149-1.

8.7 Retests and resubmission for testing

Retests and resubmission for testing shall be in accordance with EN 10149-1.

8.8 Inspection documents

The inspection documents shall comply with EN 10149-1.

9 Marking

The marking shall comply with EN 10149-1.

See EN 10149-1:2013, Clause 11, option 11).

10 Disputes

In case of disputes EN 10149-1 applies.

11 Options

See EN 10149-1:2013, Clause 11, options 1) to 11).

12) The sulphur content shall be max. 0,010 % (ladle analysis) (see Table 1).

13) The values of the mechanical properties after heating of S900MC and S960MC at temperatures above 400 ^{o}C shall be agreed at the time of the order (see 7.4.1)

Table 1 — Chemical composition of the ladle analysis for thermomechanically rolled steels

Designation of steel grade		C % max.	Mn % max.	Si % max.	P % max.	S % max.	Al total % min.	Nb % max.	V % max.	Ti % max.	Mo % max.	B % max.
Steel name	Steel number											
S315MC	1.0972	0,12	1,30	0,50	0,025	0,020[b]	0,015	0,09[a]	0,20 [a]	0,15 [a]	-	-
S355MC	1.0976	0,12	1,50	0,50	0,025	0,020[b]	0,015	0,09 [a]	0,20 [a]	0,15 [a]	-	-
S420MC	1.0980	0,12	1,60	0,50	0,025	0,015[b]	0,015	0,09 [a]	0,20 [a]	0,15 [a]	-	-
S460MC	1.0982	0,12	1,60	0,50	0,025	0,015[b]	0,015	0,09 [a]	0,20 [a]	0,15 [a]	-	-
S500MC	1.0984	0,12	1,70	0,50	0,025	0,015[b]	0,015	0,09 [a]	0,20 [a]	0,15 [a]	-	-
S550MC	1.0986	0,12	1,80	0,50	0,025	0,015[b]	0,015	0,09 [a]	0,20 [a]	0,15 [a]	-	-
S600MC	1.8969	0,12	1,90	0,50	0,025	0,015[b]	0,015	0,09 [a]	0,20 [a]	0,22 [a]	0,50	0,005
S650MC	1.8976	0,12	2,00	0,60	0,025	0,015[b]	0,015	0,09 [a]	0,20 [a]	0,22 [a]	0,50	0,005
S700MC	1.8974	0,12	2,10	0,60	0,025	0,015[b]	0,015	0,09 [a]	0,20 [a]	0,22 [a]	0,50	0,005
S900MC	1.8798	0,20	2,20	0,60	0,025	0,010	0,015	0,09	0,20	0,25	1,00	0,005
S960MC	1.8799	0,20	2,20	0,60	0,025	0,010	0,015	0,09	0,20	0,25	1,00	0,005

[a] The sum of Nb, V and Ti shall be max. 0,22 %.

[b] If agreed at the time of the order the sulphur content shall be max. 0,010 % (ladle analysis).
See Clause 11, option 12).

Table 2 — Mechanical properties for thermomechanically rolled steels

Designation of steel grade		Minimum yield strength R_{eH} MPa [a, e]	Tensile strength R_m MPa [a, e]	Minimum percentage elongation at fracture A % [a] Nominal thickness in mm		Bending at 180° minimum mandrel diameter [b, c]
Steel name	Steel number			< 3 L_o= 80 mm	≥ 3 L_o = 5,65 $\sqrt{S_o}$	
S315MC	1.0972	315	390 - 510	20	24	0*t*
S355MC	1.0976	355	430 - 550	19	23	0,5*t*
S420MC	1.0980	420	480 - 620	16	19	0,5*t*
S460MC	1.0982	460	520 - 670	14	17	1*t*
S500MC	1.0984	500	550 - 700	12	14	1*t*
S550MC	1.0986	550	600 - 760	12	14	1,5*t*
S600MC	1.8969	600	650 - 820	11	13	1,5*t*
S650MC	1.8976	650 [d]	700 - 880	10	12	2*t*
S700MC	1.8974	700 [d]	750 - 950	10	12	2*t*
S900MC	1.8798	900	930 – 1 200	7	8	8*t* [f]
S960MC	1.8799	960	980 – 1 250	6	7	9*t* [g]

[a] The values for the tensile test apply to longitudinal test pieces.

[b] The values for the bend test apply to transverse test pieces.

[c] *t* = thickness in mm of test piece for bend test.

[d] For thicknesses > 8 mm the minimum yield strength can be 20 MPa [e] lower.

[e] 1MPa = 1N/mm^2.

[f] Bending at 90 °, for thicknesses less than 3 mm minimum mandrel diameter 7*t*.

[g] Bending at 90 °, for thicknesses less than 3 mm minimum mandrel diameter 8*t*.

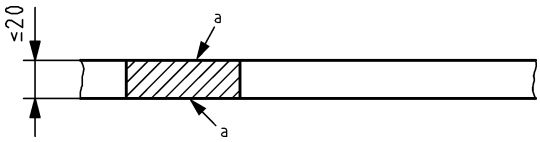
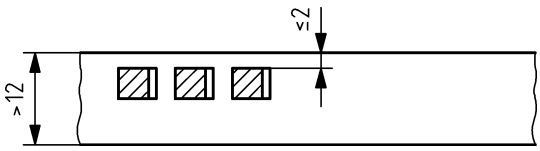
Annex A
(normative)

Location of test pieces

This annex gives the location of test pieces.

Table A.1 – Location of test pieces

Dimensions in millimetres

Type of test	Thickness of product	Orientation of the test pieces for widths of		Distance of the test piece from the rolled surface
		< 600	≥ 600	
Tension	≤ 20	longitudinal	longitudinal	
Bend	≤ 20	transverse	transverse	
Impact	> 12	longitudinal	longitudinal	
[a] Rolled surface.				

Annex B
(informative)

Minimum inside bend radii for cold forming

Table B.1 — Minimum inside bend radii for cold forming

Designation of steel grade		Minimum recommended inside bend radii for nominal thicknesses (t) in mm [a]		
Steel name	Steel number	$t \leq 3$	$3 < t \leq 6$	$t > 6$
S315MC	1.0972	0,25t	0,5t	1,0t
S355MC	1.0976	0,25t	0,5t	1,0t
S420MC	1.0980	0,5t	1,0t	1,5t
S460MC	1.0982	0,5t	1,0t	1,5t
S500MC	1.0984	1,0t	1,5t	2,0t
S550MC	1.0986	1,0t	1,5t	2,0t
S600MC	1.8969	1,0t	1,5t	2,0t
S650MC	1.8976	1,5t	2,0t	2,5t
S700MC	1.8974	1,5t	2,0t	2,5t
S900MC	1.8798	3,5t	4,0t	4,5t
S960MC	1.8799	4,0t	4,5t	5,0t

[a] The values are applicable for bend angles ≤ 90°.

Bibliography

[1] CEN/TR 10347, *Guidance for forming of structural steels in processing*

[2] EN 10020, *Definition and classification of grades of steel*

[3] EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods (ISO 1461)*

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