UDC 669.14.018.29.018.62-122.4-4 : 620.1

April 1993

Hot rolled products made from weldable, fine grain structural steel

General technical delivery conditions
English version of DIN EN 10113 Part 1

DIN EN 10113
Part 1

Warmgewalzte Erzeugnisse aus schweißgeeigneten Feinkornbaustählen; allgemeine Lieferbedingungen

This standard, together with the April 1993 editions of DIN EN 10028 Parts 1 and 3 and DIN EN 10113 Part 2, supersedes DIN 17102, October 1983 edition.

European Standard EN 10113-1 : 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.*

The present standard 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 Part 3, for thermo-mechanically rolled steel.

The DIN Standards corresponding to the standards and other documents referred to in clause 2 of the EN are as follows:

prEN 10052	DIN 17014 Part 1	EURONORM 59	DIN 1014 Part 1
prEN 10056	DIN EN 10056*), DIN 1028 and DIN 1029	EURONORM 60	DIN 1013 Part 1
		EURONORM 61	DIN 1015
EN 10204	DIN 50049	EURONORM 65	DIN 59130
EURONORM 19	DIN 1025 Part 5	EURONORM 66	DIN 1018
EURONORM 24	DIN 1025 Part 1	EURONORM 67	DIN EN 10067*)
EURONORM 48	DIN EN 10048*)	EURONORM 91	DIN 59200
EURONORM 53	DIN 1025 Parts 2 to 4	EURONORM 103	DIN 50601
EURONORM 54	DIN 1026	EURONORM 162	DIN 59413
EURONORM 55	DIN EN 10555*)	EURONORM Information circular No. 2	*Stahl-Eisen-Werkstoffblatt* (Iron and steel materials sheet) 088
EURONORM 56	DIN EN 10056 Part 2*) and DIN 1028	ECISS Information circular IC 10	DIN V 17006 Part 100
EURONORM 57	DIN EN 10056 Part 2*) and DIN 1029		
EURONORM 58	DIN 1017 Part 1		

Standards referred to

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

DIN 1013 Part 1	Hot rolled round steel for general applications; dimensions and tolerances
DIN 1014 Part 1	Hot rolled square steel for general applications; dimensions and tolerances
DIN 1015	Hot rolled steel hexagons for general applications; dimensions and tolerances
DIN 1017 Part 1	Hot rolled steel flats for general applications; dimensions and tolerances

Continued on pages 2 and 3.

EN comprises 13 pages.

*) At present at the stage of draft.

DIN 1018	Hot rolled steel half-rounds and flattened half-rounds; dimensions, tolerances and mass
DIN 1025 Part 1	Steel sections; hot rolled narrow flange I beams (I series); dimensions, mass, limit deviations and static values
DIN 1025 Part 2	Steel sections; hot rolled wide flange I beams (IPB and IP series); dimensions, mass, limit deviations and static values
DIN 1025 Part 3	Hot rolled wide flange I sections, light duty (IPBl series); dimensions, mass, limit deviations and static values
DIN 1025 Part 4	Hot rolled wide flange I sections, heavy duty (IPBv series); dimensions, mass, limit deviations and static values
DIN 1025 Part 5	Hot rolled I sections of medium flange width (IPE series); dimensions, mass, limit deviations and static values
DIN 1026	Steel sections; hot rolled round-edged channel sections; dimensions, mass, limit deviations and static values
DIN 1028	Steel sections; hot rolled round-edged equal angles; dimensions, mass, limit deviations and static values
DIN 1029	Steel sections; hot rolled round-edged unequal angles; dimensions, mass, limit deviations and static values
DIN V 17006 Part 100	Designation systems for steel; additional symbols for steel names
DIN 17014 Part 1	Heat treatment of ferrous materials; terminology
DIN 50049	Inspection documents for the delivery of metallic products
DIN 50601	Determination of grain size of ferrite or austenite in ferrous materials by metallographic methods
DIN 59130	Hot rolled round steel for bolts, screws and rivets; dimensions and tolerances
DIN 59200	Hot rolled wide steel flats; dimensions and tolerances on size, form and mass
DIN 59413	Cold rolled steel sections; tolerances on size, form and mass
DIN EN 10028 Part 3	Flat products made from steel for pressure purposes; weldable, normalized, fine grain steels
DIN EN 10048	(at present at the stage of draft) Hot rolled uncoated narrow strip; dimensions and tolerances
DIN EN 10055	(at present at the stage of draft) Hot rolled round-edged tee sections; tolerances on shape and dimensions
DIN EN 10056 Part 2	(at present at the stage of draft) Hot rolled equal and unequal leg angles; tolerances on shape and dimensions
DIN EN 10067	(at present at the stage of draft) Hot rolled beaded flats; tolerances on shape and dimensions
DIN EN 10113 Part 2	Hot rolled products made from weldable, fine grain structural steel; delivery conditions for normalized rolled steel
DIN EN 10113 Part 3	Hot rolled products made from weldable, fine grain structural steel; delivery conditions for thermomechanically rolled steel

Stahl-Eisen-Werkstoffblatt 088*) *Schweißgeeignete Feinkornbaustähle; Richtlinien für die Verarbeitung, besonders für das Schmelzschweißen* (Weldable fine grain structural steel; information on processing, particularly on fusion welding)

Previous edition

DIN 17102: 10.83.

Amendments

In comparison with the October 1983 edition of DIN 17102, the following amendments have been made.

a) The field of application is now limited to steel for use in structural steelwork.
b) Specifications for normalized products have been split up between Parts 1 and 2.
c) Specifications regarding thermomechanically rolled products are included for the first time (cf. DIN EN 10113 Part 3).
d) The text has been completely revised.

International Patent Classification

C 21 D 001/00
B 22 D 011/06
G 01 B 021/02
G 01 N 033/20

*) Obtainable from *Verlag Stahleisen mbH*, Sohnstraße 65, D-40237 Düsseldorf.

Editor's note

*This standard reproduces the official text of the English version of EN 10113-1 as issued by CEN. In its preparation for publication as DIN EN 10113 Part 1 (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 ease of comprehension, Note 1 to subclause 3.6 should be amended to read: 'Subsequently heating the material to a temperature above 580°C may decrease its strength. Where such temperatures are required, the supplier shall be consulted.'*

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 sake of clarity, subclause 6.1.1 should be amended to read: 'Parts 2 and 3 of this European Standard specify steel grades that are classified in EN 10020 as unalloyed quality steels and alloy special steels.'*

4 *For ease of reading, subclause 6.1.2 should be amended to read: 'The steel grades specified in Parts 2 and 3 of this European Standard are grouped according to their specified minimum yield strength at ambient temperature. Subject to agreement at the time of ordering, all of the grades may be supplied with specified minimum values of impact energy at temperatures down to either -20°C or -50°C.'*

5 *For ease of reading, the second sentence of the Note to subclause 7.4.1.1 should be amended to read: 'If such treatment is intended, agreement is to be reached at the time of ordering on the minimum values of mechanical properties which the material is to have following such treatment.'*

6 *By way of correction, the first paragraph of subclause 7.4.2.3 should read: 'Subject to agreement at the time of ordering, impact energy may be determined on transverse test pieces instead of longitudinal ones, in which case the values are to comply with the specifications given in table 5 of Part 2 or 3 of this European Standard.'*

7 *To make the sense complete, Note 2 to subclause 7.5.1 should be amended to read: 'Reference may be made to relevant codes of practice (e.g. EU IC 2[4])), or to national standards, with regard to the welding conditions and the degree of weldability of the various steel grades, as a function of product thickness...'*

8 *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 and in item 11) of subclause 11.2 should be replaced by the above terms.*

9 *For the sake of clarity, subclause 7.6.1 should be amended to read: 'The surface condition of strip shall be consistent with the particular application.'*

10 *To avoid confusion, the heading of subclause 8.2 should read: 'Test batch', and the text: 'The mechanical properties shall be determined using test batches originating from separate casts.'*

11 *For the sake of accuracy, the last sentence of subclause 8.5.1.3 should be amended to read: 'In the case of narrow strip ... from the end and so that its axis coincides with a line that is one-third of the product width away from the product edge.'*

12 *For the sake of accuracy, item c) of subclause 8.5.2.3 should be amended to read: 'For plate with a nominal thickness ≥ 40 mm, impact test pieces shall be taken so that their axis coincides with a line that is one-fourth of the product width away from the product edge.'*

13 *In compliance with common terminology, 'I beams and H beams' should be substituted for 'broad flanged beams with parallel flanges and IPE beams' in the second item of subclause 8.6.3 and in item 16) of subclause 11.3.*

14 *For the sake of comprehension, the second paragraph of subclause 8.7 should be amended to read: 'In the case of a rejected coil of strip, a maximum of 20 m shall be removed from the coil prior to retesting in order to preclude any influence the coil end may have on the tests.'*

15 *To make the sense complete, the second sentence of subclause 8.8 should be amended to read: 'The details specified in EURONORM 168 for categories A, B and Z and sections C 01 to C 03, C 10 to C 13, C 40 to C 43 and C 71 to C 92, shall be included in the document.'*

16 *To facilitate comprehension, subclause 9.3 should be amended to read: 'It may be specified at the time of ordering that marking is not to be effected by means of stamping, or that stamping is only to be carried out on a particular part of the product, this part being specified by the purchaser.'*

17 *To clarify the sense, item 5) of subclause 11.1 should be amended to read: 'Whether impact energy is to be determined using transverse test pieces (see 7.4.2.3).'*

18 *For the sake of accuracy, footnote 3 to figure A.2 should be amended to read: 'For products of round cross section, the notch axis on the test piece shall run approximately parallel to the product diameter, and for those of rectangular cross section, it shall be normal to the long side of the section.'*

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 10113-1

March 1993

UDC 669.14.018.29.018.62-122.4-4:620.1

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

English version

Hot rolled products in weldable, fine grain structural steels
Part 1: General delivery conditions

Produits laminés à chaud en aciers de construction soudable à grains fins.
Partie 1: Conditions générales de livraison

Warmgewalzte Erzeugnisse aus schweißgeeigneten Feinkornbaustählen.
Teil 1: Allgemeine Lieferbedingungen

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

Ref. No. EN 10113-1:1993 E

Contents

Foreword

This European Standard has been drawn up by ECISS/TC 10 'Structural steel; quality standards', the Secretariat of which is held by NNI.

This European Standard replaces EURONORM 113-72 'Special quality weldable structural steel grades and quality; general provisions'.

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

1.1 This European Standard specifies requirements for long products and flat products of hot-rolled weldable fine grain structural quality and special steels.

Part 1 of this European Standard specifies general technical delivery conditions.

Part 2 of this European Standard specifies technical delivery conditions for normalized steels in the grades and qualities given in table 1 (chemical composition) and tables 3 and 4 (mechanical properties), respectively, of that Part.

NOTE: Whenever the term 'normalizing' is used, it includes 'normalizing rolling' (see 7.2 of Part 2).

Part 3 of this European Standard specifies technical delivery conditions for thermomechanically rolled steels in the grades and qualities given in table 1 (chemical composition) and tables 3 and 4 (mechanical properties), respectively, of that Part.

The steels specified in this European Standard are especially intended for use in welded structures subjected to heavy loading such as bridges, flood gates, storage tanks, water supply tanks, etc., for service at ambient and low temperatures.

1.2 This European Standard does not apply to products for which other EURONORMs exist or European Standards dealing with steels for general structural purposes are being prepared, e.g.

- hot rolled products made from unalloyed structural steels (see EN 10025);
- semi-finished products for forging made from general-purpose structural steels (see EURONORM 30);
- weathering-resistant steels for structural purposes (see EN 10155);
- plate and wide flats made from weldable, fine grain steel in the quenched and tempered condition for use in structural steelwork (see prEN 10137);
- flat products, made from steel with high yield strength, for cold forming: wide flats, sheet/plate and wide and narrow strip (see prEN 10149);
- steels for shipbuilding; normal and high strength qualities (see EURONORM 156);
- hot formed structural hollow sections (see prEN 10210-1).

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.

2.1 General technical delivery conditions

EN 10020	Definition and classification of steel
EN 10021	General technical delivery conditions for steel and steel products
EN 10027-1	Designation systems for steel. Part 1: Steel names, principal symbols
EN 10027-2	Designation systems for steel. Part 2: Numerical system
EN 10079	Definition of steel products
EN 10163	Delivery requirements for the surface condition of hot-rolled steel plates, wide flats and sections Part 1: General requirements Part 2: Plates and wide flats Part 3: Sections
EN 10204	Metallic products; types of inspection documents
prEN 10052[1]	Vocabulary of heat treatment terms for ferrous products
EURONORM 162-81[2]	Cold-rolled sections; technical conditions of delivery
EURONORM 168-86[2]	Iron and steel products; contents of inspection documents
EU IC 2:1983[2]	Weldable fine-grained structural steels; recommendations for processing, in particular for welding
ECISS IC 10	Designation systems for steel; additional symbols for steel names

2.2 Standards on dimensions and tolerances

EN 10029	Hot-rolled plates 3 mm thick or above; tolerances on dimensions, shape and mass
EN 10051	Continuously hot-rolled uncoated sheet and strip of non-alloy and alloy steels; tolerances on dimensions and shape
prEN 10034[1]	Structural steel I and H sections; tolerances on shape and dimensions
prEN 10056-2[1]	Structural steel equal and unequal leg angles. Part 2: Tolerances on shape and dimensions
EURONORM 19-57[2]	IPE beams; parallel-flanged beams
EURONORM 24-62[2]	Standard beams and channel sections; tolerances
EURONORM 48-84[2]	Hot-rolled narrow steel strip; tolerances on dimensions, shape and mass
EURONORM 53-62[2]	Wide-flanged beams with parallel flanges
EURONORM 54-80[2]	Small hot-rolled steel channels
EURONORM 55-80[2]	Hot-rolled equal flange tees with radiused root and toes in steel
EURONORM 56-77[2] [3]	Hot-rolled equal angles (with radiused root and toes)
EURONORM 57-78[2] [3]	Hot-rolled unequal angles (with radiused root and toes)
EURONORM 58-78[2]	Hot-rolled flats for general purposes
EURONORM 59-78[2]	Hot-rolled square bars for general purposes
EURONORM 60-79[2]	Hot-rolled round bars for general purposes
EURONORM 61-82[2]	Hot-rolled steel hexagons
EURONORM 65-80[2]	Hot-rolled round steel bars for screws and rivets
EURONORM 66-67[2]	Hot-rolled half-rounds and flattened half-rounds
EURONORM 67-78[2]	Hot-rolled bulb flats
EURONORM 91-81[2]	Hot-rolled wide flats; tolerances on dimensions, shape and mass

2.3 Standards on testing

EN 10002-1	Metallic materials; tensile testing. Part 1: Method of test at ambient temperature
EN 10045-1	Metallic materials; Charpy impact test. Part 1: Test method
EN 10164	Steel products with improved deformation properties perpendicular to the surface of the product; technical delivery conditions
EURONORM 18-79[2]	Selection and preparation of samples and test pieces for steel and iron and steel products
EURONORM 103-71[2]	Microscopic determination of the ferritic and austenitic grain size of steel
EURONORM 160-85[2]	Manual ultrasonic testing of steel plate in thicknesses ≥ 6 mm (reflection method)
EURONORM 186-87[2]	Ultrasonic testing of broad flanged beams with parallel flanges and IPE beams
ISO 2566-1:1984	Steel; conversion of elongation values. Part 1: Carbon and low alloy steels

[1] At present at the stage of draft.

[2] Prior to adoption as European Standards, these EURONORMs or a corresponding national standard (the list of which is given in Annex B to this European Standard) may be applied.

[3] EURONORMs 56 and 57 are included because they specify nominal dimensions.

3 Definitions

For the purposes of this European Standard, the following definitions apply.

3.1 unalloyed quality steel and alloy special steel: As defined in EN 10020.

3.2 long products and flat products (plate, sheet, narrow strip, wide strip and wide flats): As defined in EN 10079.

3.3 heat treatment terminology: As defined in prEN 10052.

3.4 fine grain steel: Steel with fine-grained structure, with a ferritic grain size index of 6 or higher, as determined in accordance with EURONORM 103.

3.5 normalizing rolling: A rolling process in which the final deformation is carried out within a certain temperature range, which results in a material condition that is equivalent to that obtained after normalizing, so that the specified mechanical properties are retained even after subsequent normalizing.

The symbol N shall be used to designate this condition.

NOTE: In international publications, the term 'controlled rolling' is often used to mean both 'normalizing rolling' and 'thermomechanical rolling'. However, in view of the different uses of the products, a distinction between the terms is necessary.

3.6 thermomechanical rolling: A rolling process in which the final deformation is carried out within a certain temperature range, which results in a material condition which cannot be achieved or repeated by heat treatment alone.

The symbol M shall be used to designate this condition.

NOTE 1: Subsequent heating above 580 °C may lower the strength values. If temperatures above 580 °C are needed reference shall be made to the supplier.+)

NOTE 2: Thermomechanical rolling may include processes with increased cooling rates, with or without tempering (including self-tempering), but not direct hardening nor quenching and quenching and tempering in liquid.

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, quality and as delivered condition of the steel (see Parts 2 and 3 of this European Standard);

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

Where no such 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

Dimensions and tolerances shall be in accordance with the relevant European Standards and EURONORMS (see 2.2).

5.2 Mass

The calculated mass shall be determined using a density of 7,85 kg/dm³.

6 Classification into grades and designation

6.1 Classification into grades

6.1.1 Main quality classes

Classification shall be in accordance with Parts 2 and 3 of this European Standard which specify steel grades that are non-alloy quality steels or alloy special steels according to EN 10020.+)

6.1.2 Subgroups

The steel designations for flat products and long products specified in Parts 2 and 3 of this European Standard are subdivided in grades on the basis of the minimum specified yield strength at ambient temperature. All the grades can be delivered in the following qualities as specified at the time of the enquiry and order:

- with specified minimum values of impact energy at temperatures not lower than −20 °C;
- with specified minimum values of impact energy at temperatures not lower than −50 °C.+)

6.2 Designation

6.2.1 For the steel grades covered by this European Standard, the steel names are in accordance with EN 10027-1 and ECISS IC 10, and the material numbers are in accordance with EN 10027-2.

NOTE: For a list of corresponding former national designations and the former designations used in EURONORM 113-72, see Annex C, table C.1.

6.2.2 The designation shall consist of:

- the number of this European Standard (EN 10113-2 or EN 10113-3);
- the symbol S;
- the minimum specified yield strength for thicknesses ≤ 16 mm, in N/mm²;
- the symbol denoting the as delivered condition (N or M) (see Parts 2 and 3 of this European Standard);
- the symbol L, denoting the subgroup with specified minimum values of impact energy at temperatures down to −50 °C.

7 Technical requirements

7.1 Steelmaking process

7.1.1 The steelmaking process shall be at the manufacturer's discretion. If so agreed at the time of ordering, the steelmaking process shall be reported to the purchaser.

Option 1.

7.1.2 The steels shall have a fine-grained structure and contain nitrogen-binding elements in sufficient amounts.

7.2 As delivered condition

7.2.1 Normalized steel

The as delivered condition for normalized steel for flat and long products as defined in clause 3 is given in Part 2 of this European Standard.

7.2.2 Thermomechanically rolled steel

The as delivered condition for thermomechanically rolled steel for flat and long products as defined in clause 3 is given in Part 3 of this European Standard.

7.3 Chemical composition

7.3.1 The chemical composition, as determined by ladle analysis, shall comply with the values specified in Parts 2 and 3 of this European Standard.

7.3.2 In Parts 2 and 3 of this European Standard, the chemical composition of the various steel grades has been specified by giving either limit values or ranges. 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 the values indicated in table 2 of Parts 2 and 3 shall apply, which shall be calculated from the following equation:

$$CEV = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

Option 2.

7.3.4 A product analysis shall be carried out when specified at the time of ordering.

Option 3.

Table 1 shall apply for the limit deviations for the product analysis from the limiting values specified for the ladle analysis.

7.4 Mechanical properties

7.4.1 General

7.4.1.1 When tested in accordance with clause 8, in the as delivered condition specified in 7.2, the mechanical properties and the impact energy of the material shall comply with the relevant requirements of Parts 2 and 3 of this European Standard.

NOTE: Stress-relieving at temperatures exceeding 580 °C or for periods longer than 1 h may lead to a deterioration of mechanical properties. If the purchaser intends to stress relief anneal the products at higher temperatures or for longer times the minimum values of the mechanical properties after such a treatment should be agreed at the time of the enquiry and order.*)

7.4.1.2 The nominal thickness shall be regarded as the thickness of flat products. In the case of long products of irregular cross section, the nominal thickness of the part from which samples are taken shall be regarded as their thickness (see Annex A).

7.4.2 Impact energy

7.4.2.1 Unless otherwise agreed (see 7.4.2.2 and 7.4.2.3), determination of impact energy shall be carried out on longitudinal test pieces for the as delivered condition:

- N or M at −20 °C;
- NL or ML at −50 °C.

7.4.2.2 At the time of ordering, a different temperature (as given in tables 4 and 5 of Parts 2 and 3) may be agreed.

Option 4.

7.4.2.3 If agreed at the time of the enquiry and order transverse impact values as given in table 5 of Parts 2 and 3 of this European Standard shall apply instead of longitudinal values.*)

Option 5.

7.4.2.4 If the nominal product thickness is not sufficient for the preparation of full size impact test pieces, narrower test pieces shall be taken (see 8.5.2.3), and the relevant values decreased accordingly.

NOTE: Impact testing is not possible for nominal thicknesses ≤6 mm.

7.4.3 Improved deformation properties perpendicular to the product surface

If agreed at the time of ordering, flat and long products shall have improved deformation properties perpendicular to the product surface as specified in EN 10 164.

Option 6.

7.5 Technological properties

7.5.1 Weldability

The steels specified in this European Standard shall be suitable for welding processes in current use.

NOTE 1: With increasing product thickness and strength, cold cracking can occur, this being due to the combined effects of the following factors:

- the amount of diffusible hydrogen in the weld metal;
- a brittle structure in the heat-affected zone;
- a high concentration of tensile stresses in the welded joint.

NOTE 2: When using recommendations as laid down, for example in EU IC 2*) or any relevant national standard, the recommended welding conditions and the various welding ranges of the steel grades can be determined as a function of product thickness, the applied welding energy, the design requirements, the electrode efficiency, the welding process and the weld metal properties.*)

7.5.2 Formability

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

7.5.2.1 Hot forming

The suitability for hot forming is specified in Parts 2 and 3 of this European Standard.

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 shall be suitable for flanging,*) without cracking, as given in Parts 2 and 3 of this European Standard.

Option 11.

7.5.2.2.2 Roll forming

If specified at the time of ordering, plate and strip shall be suitable for the production of sections by means of cold forming, without cracking (e.g. in accordance with EURONORM 162), as given in Parts 2 and 3 of this European Standard.

Option 12.

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*) Intended for adoption as a European Standard covering the arc welding of ferritic steel.

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

7.6.1 Strip

The surface condition shall not impair an application appropriate to the steel grade if adequate processing of the strip is applied.+)

7.6.2 Plate, wide flats and long products

EN 10163 shall apply for permissible surface imperfections and their repair by grinding and/or welding.

Unless otherwise agreed, repair by welding is not permitted.

Option 8.

7.7 Internal defects

The products shall be free from internal defects which would render them unsuitable for customary use.

Ultrasonic testing may be agreed at the time of ordering (see 8.6.3).

Option 13 (for flat products).

Option 16 (for long products).

8 Testing and inspection

8.1 General

8.1.1 The products shall undergo specific testing and inspection for compliance with the specifications of this European Standard.

8.1.2 The purchaser shall specify the desired type of inspection document at the time of ordering (see 4.1 and 8.8).

8.1.3 Specific testing and inspection shall be carried out in accordance with 8.2 to 8.7.

8.1.4 Unless otherwise agreed at the time of ordering, the check of surface condition and dimensional accuracy shall be carried out by the manufacturer.

Option 9.

8.2 Sampling+)

The verification of the mechanical properties shall be by cast.+)

8.3 Test unit

A test unit shall consist of products of the same form and grade and be within the same thickness range as used in table 3 of Parts 2 and 3 of this European Standard.

For verifying the mechanical properties, the requirements regarding test units specified in Parts 2 and 3 of this European Standard shall apply.

8.4 Determination of chemical composition

8.4.1 For ladle analysis determined for each cast, the values reported by the manufacturer shall apply.

8.4.2 Product analysis shall be carried out if agreed at the time of ordering. The purchaser shall specify the number of samples to be tested and the elements to be determined.

Option 3.

8.5 Mechanical tests

8.5.1 Sampling

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

- one sample for tensile testing;
- one sample sufficient for producing a set of six impact test pieces.

8.5.1.2 The product from which samples are taken can be any product within the test unit.

8.5.1.3 For plate, sheet, wide strip and wide flats, the samples shall be taken approximately midway between the long edge and centre line of the product.

For wide strip, the sample shall be taken at an adequate distance from the end of the coil.

For narrow strip (<600 mm wide), the sample shall be taken at an adequate distance from the end and at one third of the width.+)

8.5.1.4 For long products, EURONORM 18 shall apply (see Annex A).

8.5.2 Preparation of test pieces

8.5.2.1 General

The requirements of EURONORM 18 shall apply (see Annex A).

8.5.2.2 Tensile test pieces

The requirements of EN 10002-1 shall apply.

Test pieces may be non-proportional but in cases of dispute, proportional test pieces having an original gauge length, L_0, equal to $5{,}65\sqrt{S_0}$ shall be used (see 8.6.2.1).

For flat products with a nominal thickness <3 mm, the test pieces shall always have an original gauge length, L_0, equal to 80 mm and a width of 20 mm (test piece 2 as specified in EN 10002-1).

8.5.2.3 Impact test pieces

The test pieces shall be machined and prepared in accordance with EN 10045-1. In addition, the following shall apply:

a) For nominal thicknesses >12 mm, standard test pieces (10 mm × 10 mm) shall be machined in such a way that one side is not more than 2 mm away from a rolled surface (see figure A.3).

b) For nominal thicknesses ≤12 mm, the minimum width of test pieces shall be 5 mm (see 7.4.2.4).

c) Impact test pieces shall be taken from ¼T position for plates with nominal thickness ≥40 mm.+)

8.5.2.4 Test pieces for determining chemical composition

The preparation of samples for product analysis shall be in accordance with EURONORM 18.

8.6 Test methods

8.6.1 Chemical composition

In cases of dispute, determination of chemical composition shall be carried out in accordance with relevant European Standards or EURONORMs (see footnote 2 of clause 2).

NOTE: Prior to adoption as European Standards, these EURONORMs or a corresponding national standard may be applied.

8.6.2 Mechanical tests

Mechanical tests shall be carried out at temperatures between 10 °C and 35 °C, except where a specific temperature is specified for impact testing (see 7.4.2.1 and 7.4.2.2).

8.6.2.1 Tensile test

The tensile test shall be carried out in accordance with EN 10002-1.

The yield strength to be determined (for compliance with table 3 of Parts 2 and 3 of this European Standard) shall be the upper yield strength (R_{eH}).

If the yield strength is not pronounced, the 0,2 % proof strength, $R_{p0,2}$, or $R_{t0,5}$ shall be determined; in cases of dispute, the 0,2 % proof strength shall be determined.

If a non-proportional tensile test piece is used for products with a thickness ≥ 3 mm, the value of elongation at fracture obtained shall be converted to the value for an original gauge length, L_0, of $5{,}65\sqrt{S_0}$, using the conversion tables given in ISO 2566-1.

8.6.2.2 Impact test

The impact test shall be carried out in accordance with EN 10045-1.

The mean value obtained from three tests shall meet the specified requirement. One single value may be lower than the specified minimum value, but not less than 70 % of that value.

In any one of the following cases, three additional test pieces shall be taken from the same sample in accordance with 8.5.1 and tested:

- if the mean from three values is lower than the specified minimum value;
- if the mean value meets the specified requirement, but two single values are lower than the specified minimum value;
- if any one value is less than 70 % of the specified minimum value.

The mean from the six values shall then be not less than the specified minimum value. Not more than two single values may be lower than the specified minimum value, and not more than one may be less than 70 % of that value.

8.6.3 Ultrasonic testing

If specified at the time of ordering (see 7.7), ultrasonic testing shall be carried out

- for plate in thicknesses ≥ 6 mm, in accordance with EURONORM 160;
- for broad flanged beams with parallel flanges and IPE beams,*) in accordance with EURONORM 186.

8.7 Retests and resubmission for testing

EN 10021 shall apply in respect of all retests and resubmission for testing.

In the case of strip retests on a rejected coil shall be carried out after the cutting of an additional longitudinal section of sufficient length to remove the coil end effect with a maximum of 20 m.*)

8.8 Inspection documents

One of the inspection documents specified in EN 10204 shall be issued. In these documents the information groups A, B and Z and the code numbers C01 to C03, C10 to C13, C40 to C43 and C71 to C92 according to EURONORM 168 shall be included.*)

9 Marking

9.1 The products shall be durably marked by a suitable method (e.g. painting, stamping or attaching an adhesive label or tag) with the following particulars:

- the designation of the steel grade and the symbol denoting the as delivered condition (e.g. S355 M);
- a number by which the cast and the sample can be identified;
- the manufacturer's name or trademark;
- the mark of the inspection body (where applicable).

9.2 Marking shall be close to one end of each product or on the cut end face, at the manufacturer's discretion.

9.3 If specified at the time of the enquiry and order there shall be either no steel stamping or only steel stamping in positions indicated by the purchaser.*)

Option 10.

9.4 Where lightweight products are to be supplied in securely tied bundles, the marking shall be included on a label attached to the bundle or on the uppermost product in the bundle.

10 Complaints

EN 10021 shall apply in respect of complaints after delivery and of handling them.

11 Options (see 4.2)

11.1 All products

1) Notifying the purchaser of the steelmaking process used (see 7.1.1).

2) A required maximum value of carbon equivalent (see 7.3.3).

3) Whether a product analysis is to be carried out and if so, the number of samples to be tested and the elements to be determined (see 7.3.4 and 8.4.2).

4) A test temperature other than that indicated in 7.4.2.1, for determining the impact energy (see 7.4.2.2).

5) Whether transverse impact values are required (see 7.4.2.3).*)

6) Whether the products are to comply with the improved deformation properties perpendicular to their surface, as specified in EN 10164 (see 7.4.3).

7) Whether grades S275 or S355 are to be suitable for hot-dip galvanizing (see 7.5.3.1).

8) Whether repair by welding is permitted (see 7.6.2).

9) Whether the check for surface condition and dimensional accuracy is to be carried out by the manufacturer or by the purchaser's authorized representative (see 8.1.4).

10) Whether stamping is permitted and if so, its location on the product (see 9.3).

11.2 Flat products

11) Whether plate, sheet, strip and wide flats are to be suitable for flanging+) (see 7.5.2.2.1).

12) Whether plate, sheet, strip and wide flats are to be suitable for roll forming (see 7.5.2.2.2).

13) Whether plate with a thickness ≥ 6 mm is to be tested for internal defects in accordance with EURONORM 160 (see 7.7 and 8.6.3).

14) In the case of flat products with a nominal thickness > 30 mm, whether a round test piece may be used for the tensile test (see figure A.3).

11.3 Long products

15) Whether heavy sections are to be suitable for slitting (see 7.5.3.2).

16) Whether broad flanged beams with parallel flanges and IPE beams+) are to be tested for internal defects in accordance with EURONORM 186 (see 7.7 and 8.6.3).

Table 1: Amounts by which the chemical composition as determined by product analysis may deviate from the limiting values specified for cast analysis

Element	Limiting values as determined by cast analysis, as a percentage by mass	Limit deviation for product analysis, as a percentage by mass
C	≤ 0,20	+ 0,02
Si	≤ 0,60	+ 0,05
Mn	≤ 1,70	− 0,05 + 0,10
P	≤ 0,035	+ 0,005
S	≤ 0,030	+ 0,005
Nb	≤ 0,05	+ 0,010
V	≤ 0,20	+ 0,02
Ti	≤ 0,05	+ 0,01
Cr	≤ 0,30	+ 0,05
Ni	≤ 0,80	+ 0,05
Mo	≤ 0,20	+ 0,03
Cu	≤ 0,35 > 0,35 ≤ 0,70	+ 0,04 + 0,07
N	≤ 0,025	+ 0,002
Al_{total}	≥ 0,02	− 0,005

Annex A (normative)
Location of samples and test pieces (see EURONORM 18)

The following three types of product are covered:

- beams, channels, angles, T sections and Z sections (see figure A.1)
- bars (see figure A.2)
- flat products (see figure A.3).

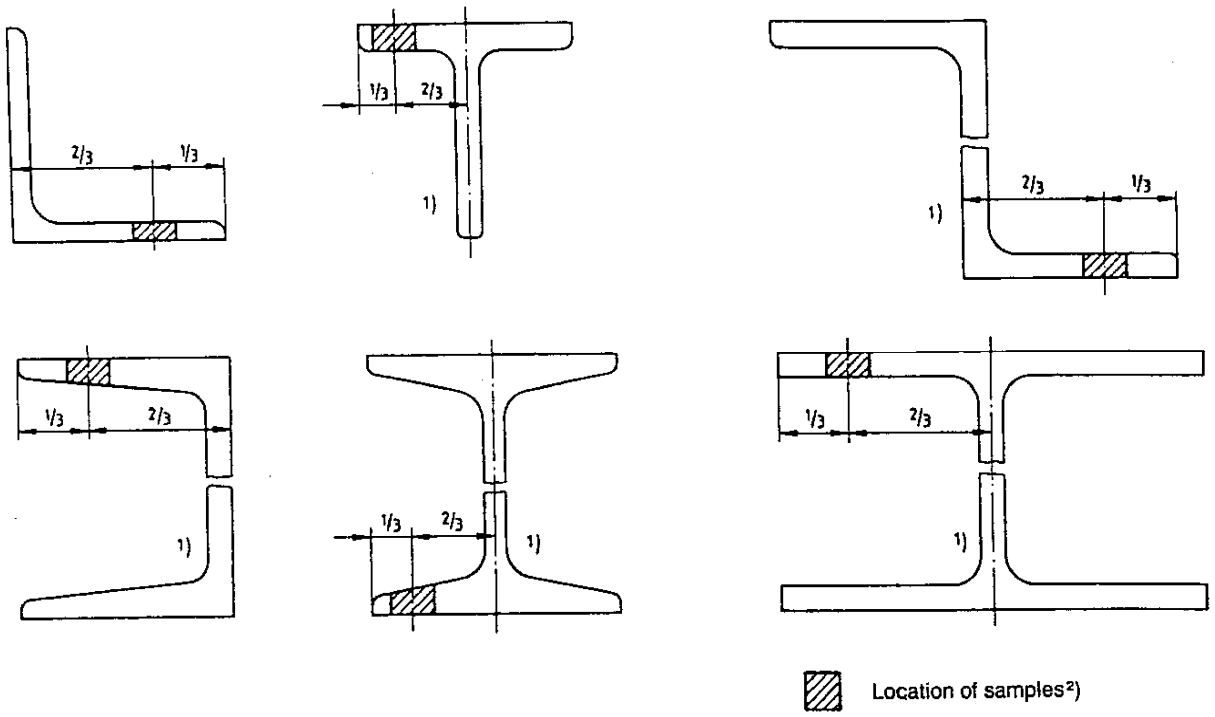

Figure A.1: Beams, channels, angles, T sections and Z sections

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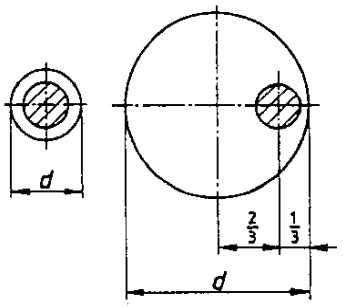
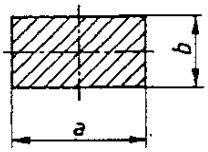
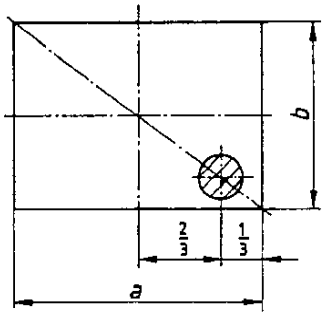
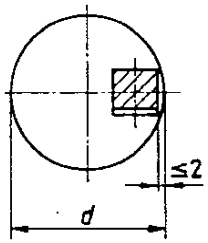
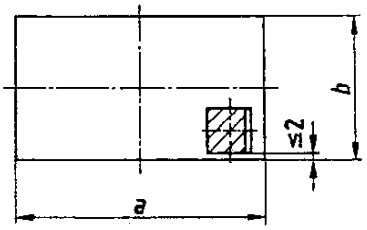
1) By agreement, the sample may be taken from the web, from a zone corresponding to one-fourth of the total height.

2) Test pieces shall be taken as illustrated in figure A.3. For sections with inclined flanges, the inclined surface may be machined to make it parallel with the other surface.

Dimensions in millimetres

Type of steel	Type of test piece	Products of circular cross section	Products of rectangular cross section
Structural steel	Tensile test piece	$d \leq 25$ [1]  $d > 25$ [2]	$b \leq 25$ [1]  $b > 25$ [2] 
	Impact test piece[3]	$d \geq 16$ 	$b \geq 12$ 

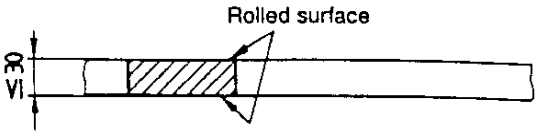
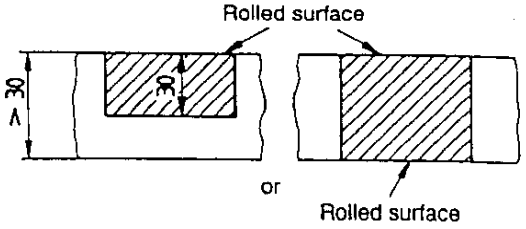
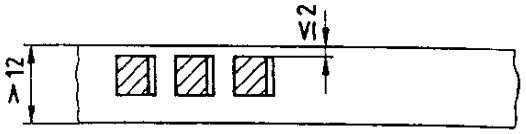
[1]) For small products (d or $b \leq 25$ mm), the unmachined sample shall be used as the test piece.

[2]) For products of diameter or thickness ≤40 mm, the manufacturer may either:

- comply with the requirements specified for products of diameter or thickness ≤25 mm, or
- take the test piece from a location that is closer to the centre than indicated in the figure.

[3]) For products of round cross section, the axis of the notch is approximately a diameter. For products with rectangular cross section, the axis of the notch is perpendicular to the greatest rolled surface.*)

Figure A.2: Bars

Type of test	Thickness of product mm	Orientation of longitudinal axis of test pieces for widths of		Distance of test pieces from rolled surface mm
		< 600 mm	≥ 600 mm	
Tensile[1])	≤ 30	Longitudinal	Transverse	
	> 30			
Impact[2])	> 12	Longitudinal	Longitudinal	

[1]) In case of doubt or dispute, for products of thicknesses ≥ 3 mm, test pieces shall have an original gauge length, L_0, equal to $5{,}65\sqrt{S_0}$.

For economic reasons, test pieces with a constant gauge length may be used, provided the result obtained for elongation at fracture is converted by a recognized formula (see, for example, ISO 2566-1). For products with a thickness > 30 mm, a round test piece may be used, subject to agreement.

Option 14.

[2]) The longitudinal axis of the notch shall be perpendicular to the rolled surface of the product.

Figure A.3: Flat products

Annex B (informative)
List of national standards which correspond to the EURONORMs referred to

Prior to adoption as European Standards, these EURONORMs or a corresponding national standard may be applied.

Table B.1: EURONORMs and related national standards

EURONORM	Corresponding national standard in									
	Germany	France	United Kingdom	Spain	Italy	Belgium NBN	Portugal NP-	Sweden	Austria	Norway NS
18		NF A 03 111	BS 4360	UNE 36-300	UNI-EU 18	A 03-001	2451	SS 11 01 20		10 005
				UNE 36-400				SS 11 01 05		10 006
19	DIN 1025 T 5	NF A 45 205	–	UNE 36-526	UNI 5398	533	2116	SS 21 27 40	M 3262	–
24	DIN 1025 T 1	NF A 45 210	BS 4	UNE 36-521	UNI 5679	632-01	–	SS 21 27 25	M 3261	911
	DIN 1026			UNE 36-522	UNI 5680			SS 21 27 35		
48	DIN 1016	NF A 46 100	BS 1449	UNE 36-553	UNI 6685	–	–	–	DIN 1016	–
53	DIN 1025 T 2	NF A 45 201	BS 4	UNE 36-527	UNI 5397	633	2117	SS 21 27 50	–	1907
	DIN 1025 T 3			UNE 36-528				SS 21 27 51		1908
	DIN 1025 T 4			UNE 36-529				SS 21 27 52		
54	DIN 1026	NF A 45 007	BS 4	UNE 36-525	UNI-EU 54	A 24-204	338	–	M 3260	–
55	DIN 1024	NF A 45 008 [1]	BS 4	UNE 36-533	UNI-EU 55	A 24-205	337	SS 21 27 20	–	1905
56	DIN 1028	NF A 45 009 [1]	BS 4848	UNE 36-531	UNI-EU 56	A 24-201	335	SS 21 27 11	M 3246	1903
57	DIN 1029	NF A 45 010 [1]	BS 4848	UNE 36-532	UNI-EU 57	A 34-202	336	SS 21 21 12	M 3247	1904
58	DIN 1017 T 1	NF A 45 005 [1]	BS 4360	UNE 36-543	UNI-EU 58	A 34-201	–	SS 21 21 50	M 3230	1902
59	DIN 1014 T 1	NF A 45 004 [1]	BS 4360	UNE 36-542	UNI-EU 59	A 34-202	333 + 334	SS 21 27 25	M 3226	1901
60	DIN 1013 T 1	NF A 45 003 [1]	BS 4360	UNE 36-541	UNI-EU 60	A 34-203	331	SS 21 25 02	M 3221	1900
61	DIN 1015	NF A 45 006 [1]	BS 970	UNE 36-547	UNI 7061	A 24-204	–	–	M 3237/M 3228	–
65	DIN 59 130	NF A 45 075 [1]	BS 3111	UNE 36-546	UNI 7356	A 24-206	–	–	M 3223	–
66	DIN 1018	–	–	–	UNI 6630	–	–	–	–	–
67	DIN 1019	NF A 45 011	BS 4848	UNE 36-548	UNI-EU 67	A 24-203	–	SS 21 11 70	–	6034
91	DIN 59 200	NF A 46 012	BS 4360	–	UNI-EU 91	A 43-301	–	SS 21 21 50	M 3231	–
103	DIN 50 601	NF A 04 102	BS 4490	UNE 7-280	UNI 3245	A 14-101	1787	–	–	–
160	–	NF A 04 305	BS 5996	–	UNI-EU 160		–	SS 11 42 01	–	–
162	DIN 17 118	NF A 37 101	BS 2994	UNE 36-570	UNI 7344	A 02-002	–	–	M 3316	–
	DIN 59 413	–	–	–	–					
168		NF A 03 116	BS 4360	UNE 36-800	UNI-EU 168	–	–	SS 11 00 12	–	–
186							–	–	–	–
EU IC 2	SEW 088	NF A 36 000	BS 5135	–	–	–	–	SS 06 40 25	–	–

[1]) Tolerances are specified in NF A 45 001 and NF A 45 101.

Annex C (informative)
List of related steel designations

Table C.1: List of related steel designations

Steel grade		Equivalent former designation used in					
Symbol as specified in EN 10027-1 and ECISS-IC 10	Material number as specified in EN 10027-2	EU 113-72	Germany	France	United Kingdom	Italy	Sweden
S275N	1.0490	FeE 275 KGN	StE 285	–	–	FeE 275 KGN	–
S275NL	1.0491	FeE 275 KTN	TStE 285	–	40 EE	FeE 275 KTN	–
S355N	1.0545	FeE 355 KGN	StE 355	E 355 R	–	FeE 355 KGN	2134-01
S355NL	1.0546	FeE 355 KTN	TStE 355	E 355 FP	50 EE	FeE 355 KTN	2135-01
S420N	1.8902	FeE 420 KGN	StE 420	E 420 R	–	–	–
S420NL	1.8912	FeE 420 KTN	TStE 420	E 420 FP	–	–	–
S460N	1.8901	FeE 460 KGN	StE 460	E 460 R	–	FeE 460 KGN	–
S460NL	1.8903	FeE 460 KTN	TStE 460	E 460 FP	55 EE	FeE 460 KTN	–
S275M	1.8818	FeE 275 KGTM	–	–	–	FeE 275 KGTM	–
S275ML	1.8819	FeE 275 KTTM	–	–	–	FeE 275 KTTM	–
S355M	1.8823	FeE 355 KGTM	StE 355 TM	–	–	FeE 355 KGTM	–
S355ML	1.8834	FeE 355 KTTM	TStE 355 TM	–	–	FeE 355 KTTM	–
S420M	1.8825	FeE 420 KGTM	StE 420 TM	–	–	–	–
S420ML	1.8836	FeE 420 KTTM	TStE 420 TM	–	–	–	–
S460M	1.8827	FeE 460 KGTM	StE 460 TM	–	–	FeE 460 KGTM	–
S460ML	1.8838	FeE 460 KTTM	TStE 460 TM	–	–	FeE 460 KTTM	–