

Hot rolled unalloyed structural steel products

Technical delivery conditions
(includes Amendment A1:1993)
English version of DIN EN 10025

DIN
EN 10025

Warmgewalzte Erzeugnisse aus unlegierten Baustählen; Technische Lieferbedingungen;
(enthält Änderung A1:1993)

Supersedes
January 1991 edition.

European Standard EN 10025:1990 + A1:1993 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

This standard, which includes Amendment A1:1993, 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*.

Compared to the January 1991 edition, the present standard incorporates the changes specified in Amendment A1:1993. Since EN 10027 Parts 1 and 2 and ECISS Information Circular IC 10 have also been published in the meantime, this standard also incorporates the harmonized steel designations and material numbers specified in those documents. To facilitate the introduction of these designations and numbers, table C.1 gives a list correlating those used previously in several European countries with the new ones. The former German designations are those which had been specified in the January 1980 edition of DIN 17100.

It is not intended to cover forgings in a European Standard in the near future. These had been specified in DIN 17100, and although that Standard has been withdrawn, it is recommended that it still be referred to as necessary.

The DIN Standards corresponding to the European Standard and EURONORMs referred to in clause 2 of the EN are as follows:

EURONORM 17	DIN 59 110
EURONORM 19	DIN 1025 Part 5
EURONORM 24	DIN 1026
EURONORM 53	DIN 1025 Parts 2 to 4
EURONORM 54	DIN 1026
EURONORM 56	DIN 1028
EURONORM 57	DIN 1029
EURONORM 58	DIN 1017 Part 1
EURONORM 59	DIN 1014 Part 1
EURONORM 60	DIN 1013 Part 1
EURONORM 61	DIN 1015
EURONORM 65	DIN 59 130
EURONORM 66	DIN 1018
EURONORM 91	DIN 59 200
EURONORM 103	DIN 50 601
EURONORM 162	DIN 17 118 and DIN 59 413
EN 10 204	DIN 50 049
ECISS Information circular IC 10	DIN V 17 006 Part 100

Continued overleaf.
EN comprises 37 pages.

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
DIN 1018	Hot rolled steel half-rounds and flattened half-rounds; dimensions, tolerances and mass
DIN 1025 Part 2	Hot rolled I and H sections (IPB and IB series); dimensions, mass and static parameters
DIN 1025 Part 3	Hot rolled I and H sections (IPBl series); dimensions, mass and static parameters
DIN 1025 Part 4	Hot rolled I and H sections (IPBv series); dimensions, mass and static parameters
DIN 1025 Part 5	Hot rolled I and H sections (IPE series); dimensions, mass and static parameters
DIN 1026	Steel sections; hot rolled round-edged channel sections; dimensions, mass, limit deviations and static values
DIN 1028	Hot rolled equal angles with rounded toes; dimensions, mass and static parameters
DIN 1029	Hot rolled unequal angles with rounded toes; dimensions, mass and static parameters
DIN V 17 006 Part 100	Designation systems for steel; additional symbols for steel names
DIN 17 118	Cold rolled steel sections; technical delivery conditions
DIN 50 049	Inspection documents for the delivery of metallic products
DIN 50 601	Determination of grain size of ferrite or austenite in ferrous materials by metallographic methods
DIN 59 110	Steel wire rod; dimensions, tolerances and mass
DIN 59 130	Hot rolled round steel for bolts, screws and rivets; dimensions and tolerances
DIN 59 200	Hot rolled wide steel flats; dimensions and tolerances on size, form and mass
DIN 59 413	Cold rolled steel sections; tolerances on size, form and mass

Previous editions

DIN 1611: 09.24, 01.28, 04.29, 08.30, 12.35; DIN 1612: 01.32, 03.43x; DIN 1620: 09.24, 03.58; DIN 1621: 09.24; DIN 1622: 12.33; DIN 17 100: 10.57, 09.66, 01.80; DIN EN 10025: 01.91.

Amendments

In comparison with the January 1991 edition, the following amendments have been made.

- a) The steel designations have been changed, and material numbers are included for the first time (cf. table C.1).
- b) Maximum values of carbon equivalent have been specified for steel grades S235, S275 and S355 (cf. subclause 7.3.3.1 and table 4).
- c) Maximum values of Mn content have been specified for steel grades S235 and S275 (cf. tables 2 and 3).
- d) The references to standards have been updated (cf. clause 2).

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Descriptors: Iron and steel products, structural steels, unalloyed steels, hot rolled products, quality classes, designations, specifications, chemical composition, mechanical properties, mechanical tests, inspection, marking.

English version

Hot rolled products of non-alloy structural steels
Technical delivery conditions
(includes Amendment A1:1993)

Produits laminés à chaud en aciers de construction non alliés; conditions techniques de livraison
(inclut l'amendement A1:1993)

Warmgewalzte Erzeugnisse aus unlegierten Baustählen; technische Lieferbedingungen
(enthält Änderung A1:1993)

This European Standard was approved by CEN on 1993-08-10.

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 bibliographic 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

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Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword

This European Standard has been drawn up by ECISS/TC 10 "Structural steel - qualities" whose secretariat is held by NNI.

This document established by the secretariat of ECISS/TC 10 incorporates the text of EN 10025:1990 with the text of the amendment A1:1993. This amendment was prepared on request of CEN/TC 121 "Welding" and CEN/TC 135 "Execution of steel structures". It also incorporates the new designations according to EN 10027 parts 1 and 2, IC 10 and the corrigendum dated July 1991.

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 February 1994, and conflicting national standards shall be withdrawn at the latest by February 1994.

According to the Common CEN/CENELEC Rules, the following countries are bound to implement this European Standard:

Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the 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 non-alloy, base and quality steels in the grades and qualities given in tables 2 and 3 (chemical composition) and 5 and 6 (mechanical properties) in the usual delivery condition as given in 7.2.

The steels specified in this European Standard are intended for use in welded, bolted and riveted structures, for service at ambient temperatures (subject to the restrictions described in 7.5.1). They are not intended to be heat treated except products delivered in the delivery condition N. Stress relief annealing is permitted. Products delivered in N condition may be normalized and hot formed after delivery (see clause 3).

NOTE 1: Semi-finished products which are to be converted to rolled finished products conforming to this European Standard should be the subject of special agreement at the time of the enquiry and order. The chemical composition can also be agreed at the time of enquiry and order, however the values should be within the limits of table 2.

NOTE 2: For certain grades and product forms suitability for particular applications may be specified at the time of the enquiry and order (see 7.5.3, 7.5.4 and table 7).

1.2 This European Standard does not apply to coated products and products for which other EURONORMS exist or European Standards dealing with steels for general structural applications are being prepared:

- semi-finished products for forging in general purpose structural steel - (see EURONORM 30);
- weldable fine grain structural steel - (see EN 10113 part 1 - 3);
- structural steels with improved atmospheric corrosion resistance - (see EN 10155);
- plates and wide flats made of weldable fine-grained structural steels in the quenched and tempered condition - (see prEN 10137 part 1 - 3) ¹⁾;
- flat products in high yield strength steels for cold forming - wide flats, sheet/plate, wide and narrow strip - (see prEN 10149) ¹⁾;
- steels for shipbuilding - normal and high strength qualities - (see EURONORM 156);
- hot finished structural hollow sections (EN 10210-1).

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited

1) Draft is under discussion.

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 standards

EN 10020	Definition and classification of grades of steel
EN 10021	General technical delivery requirements for steel and iron products
EN 10027-1	Designation systems for steels -- Part 1: Steel names principal symbols
EN 10027-2	Designation systems for steels -- Part 2: Numerical system
EN 10079	Definitions of steel products
EN 10163	Delivery requirements for 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 10164	Steel products with improved deformation properties perpendicular to the surface of the product -- Technical delivery conditions
EN 10204	Metallic products -- Types of inspection documents
prEN 10052	¹⁾ Vocabulary of heat treatment terms for ferrous products
EURONORM 162 (1981)	²⁾ Cold-rolled sections -- Technical conditions of delivery
EURONORM 168 (1986)	²⁾ Iron and steel products -- Inspection documents -- Contents
ECSC 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 10024	¹⁾ Taper flange I sections -- Tolerances on shape and dimensions
prEN 10034	¹⁾ Structural steel I and H sections -- Tolerances on shape and dimensions

1) Draft is under discussion.

2) Until these EURONORMS are transformed into European Standards, they can either be implemented or reference made to the corresponding national standards, the list of which is given in Annex B to this European Standard.

prEN 10048	1)	Hot rolled narrow steel strip -- Tolerances on dimensions and shape
prEN 10055	1)	Hot-rolled steel equal flange tees with radiused root and toes -- Dimensions and tolerances on shape and dimensions
prEN 10056-2	1)	Structural steel equal and unequal leg angles -- Part 2: Tolerances on shape and dimensions
prEN 10067	1)	Hot rolled bulb flats -- Dimensions and tolerances on shape and dimensions
EURONORM 17 (1970)	2)	Non-alloy base steel wire rod for cold drawing -- Dimensions and tolerances
EURONORM 19 (1957)	2)	IPE beams: parallel-flanged beams
EURONORM 24 (1962)	2) 3)	Standard beams and channel sections -- Tolerances
EURONORM 53 (1962)	2)	Wide-flanged beams with parallel flanges
EURONORM 54 (1980)	2)	Small hot-rolled steel channels
EURONORM 56 (1977)	2) 4)	Hot-rolled equal angles (with radiused root and toes)
EURONORM 57 (1978)	2) 4)	Hot-rolled unequal angles (with radiused root and toes)
EURONORM 58 (1978)	2)	Hot-rolled flats for general purposes
EURONORM 59 (1978)	2)	Hot-rolled square bars for general purposes
EURONORM 60 (1977)	2)	Hot-rolled round bars for general purposes
EURONORM 61 (1982)	2)	Hot-rolled steel hexagons
EURONORM 65 (1980)	2)	Hot-rolled round steel bars for screws and rivets
EURONORM 66 (1967)	2)	Hot-rolled half-rounds and flattened half-rounds
EURONORM 91 (1981)	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
EURONORM 18 (1979)	2)	Selection and preparation of samples and test pieces for steel and iron and steel products
EURONORM 103 (1971)	2)	Microscopic determination of the ferritic and austenitic grain size of steel
ISO 2566/1 (1984)		Steel -- Conversion of elongation values -- Part 1: Carbon and low alloy steels

- 1) Draft is under discussion.
- 2) Until these EURONORMS are transformed into European Standards, they can either be implemented or reference made to the corresponding national standards, the list of which is given in Annex B to this European Standard.
- 3) EURONORM 24 is added because it contains channel sections.
- 4) EURONORM 56 and 57 are added because they contain the nominal dimensions.

3 Definitions

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

3.1 Non-alloy base and quality steel as defined in EN 10020.

3.2 Heat treatment terms as defined in prEN 10052.

3.3 Long products, flat products (plate, sheet, narrow strip, wide strip and wide flats) and semi-finished products as defined in EN 10079.

3.4 **Normalizing rolling:** a rolling process in which the final deformation is carried out in a certain temperature range leading to a material condition equivalent to that obtained after normalizing so that the specified values of the mechanical properties are retained even after normalizing.

The abbreviated form of this delivery condition is N.

NOTE: In international publications for both the normalizing rolling, as well as the thermomechanical rolling, the expression "controlled rolling" may be found. However in view of the different applicability of the products a distinction of the terms is necessary.

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 quantity;
- b) reference to this European Standard;
- c) nominal dimensions and tolerances (see 5.1);
- d) the grade and quality of steel (see tables 2 and 5);
- e) whether products have to be submitted to inspection and testing and if inspection and testing is required which type of inspection and which inspection document is required (see 8.1.2);
- f) whether the verification of the mechanical properties for the quality JR and the steel grades E295, E335 and E360 has to be carried out by lot or by cast (see 8.3.1).

Where no specific choice is made by the purchaser concerning a), b), c) and d) the supplier shall refer back to the purchaser.

4.2 Options

A number of options are 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

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

5.2 Mass of steel

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

6 Classification of grades and qualities; designation

6.1 Classification of grades and qualities

This European Standard specifies seven steel grades S185, S235, S275, S355, E295, E 335 and E360 (see table 5), which differ in their mechanical properties.

The steel grades S235 and S275 may be supplied in qualities JR, J0 and J2. The steel grade S355 may be supplied in qualities JR, J0, J2 and K2. Products of steel grades S235 and S275 with quality J2 are subdivided into two qualities J2G3 and J2G4. Products of grade S355 with quality J2 and K2 are subdivided into two qualities respectively J2G3 and J2G4 and K2G3 and K2G4 (see 7.2).

The qualities differ in weldability and specified impact values (see also 7.5.1).

The steel grades S185, E295, E335 and E360 and the steel grades S235, S275 and S355 of quality JR are base steels, unless a suitability for cold forming is specified.

Steels of qualities J0, J2G3, J2G4, K2G3 and K2G4 are quality steels.

6.2 Designation

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

NOTE: For a list of corresponding former designations and the former designations from EN 10025:1990 see Annex C, table C.1.

- 6.2.2 The designation shall consist of:
- the number of this European Standard (EN 10025);
 - the symbol S;
 - the indication of the minimum specified yield strength for thickness ≤ 16 mm expressed in N/mm²;
 - the quality designation (see 6.1) in respect to the weldability and specified impact values;
 - if applicable (for S235JR), a indication for the deoxidation method (G1 for "rimming steel" (FU) or G2 for "rimming steel not permitted" (FN)) (see 7.1.3).
 - if applicable, the additional symbol C for the suitability for the particular application (see table 7).
 - if applicable, the indication "+N" when the products shall be delivered in the condition N (see 3.4 and table 1). (Not necessary for flat products of qualities J2G3 and K2G3).

Example: Steel EN 10025 - S355J0C

7 Technical requirements

7.1 Steel manufacturing process

7.1.1 The steel manufacturing process shall be at the manufacturer's option. If specified at the time of the enquiry and order the steel manufacturing process shall be reported to the purchaser, with the exception of steel S185.

Option 1.

For qualities J0, J2G3, J2G4, K2G3 and K2G4 a specific steel manufacturing process may be agreed at the time of the enquiry and order.

Option 2.

7.1.2 The method of deoxidation shall be as given in table 2. For steel S235JR the purchaser may specify the method of deoxidation at the time of the enquiry and order.

Option 3.

7.1.3 The deoxidation methods are designated as follows:

Optional Method at the manufacturers option

FU Rimming steel

FN Rimming steel not permitted

FF Fully killed steel containing nitrogen binding elements in amounts sufficient to bind the available nitrogen (for example min. 0,020 % Al). If other elements are used they shall be reported in the inspection document.

7.2 Delivery conditions

7.2.1 General

If an inspection document is required (see 8.1.2) and products are ordered and delivered in the condition N this shall be indicated in the document.

7.2.2 Flat products

7.2.2.1 Unless otherwise agreed flat products of the steel grades S185, E295, E335 and E360 and the steel grades S235, S275 and S355 of quality JR and JO shall be supplied in a delivery condition at the manufacturers discretion (see 7.4.1).
Option 17.

7.2.2.2 Flat products of quality J2G3 and K2G3 shall be supplied normalized or in an equivalent condition obtained by normalizing rolling as defined in 3.4.

7.2.2.3 Flat products of quality J2G4 and K2G4 shall be supplied in a delivery condition at the manufacturers discretion.

7.2.3 Long products

7.2.3.1 Unless otherwise agreed long products of the steel grades S185, E295, E335 and E360 and the steel grades S235, S275 and S355 of quality JR, JO, J2G3 and K2G3 shall be supplied in a delivery condition at the manufacturers discretion.
Option 22.

7.2.3.2 Long products of quality J2G4 and K2G4 shall be supplied in a delivery condition at the manufacturers discretion.

7.2.4 The delivery conditions are summarized in table 1.

Table 1: Delivery conditions

Grades and qualities	Delivery condition	
	Flat products	Long products
S185	Optional ¹⁾ ³⁾	Optional ¹⁾ ³⁾
S235JR, S235JO S275JR, S275JO S355JR, S355JO	Optional ¹⁾ ³⁾	Optional ¹⁾ ³⁾
S235J2G3 S275J2G3 S355J2G3, S355K2G3	N	Optional ¹⁾ ³⁾
S235J2G4 S275J2G4 S355J2G4, S355K2G4	Discretion manufacturer ²⁾	Discretion manufacturer ²⁾
E295, E335, E360	Optional ¹⁾ ³⁾	Optional ¹⁾ ³⁾
<p>1) Unless otherwise agreed at the time of the enquiry and order delivery condition at the manufacturers discretion.</p> <p>2) Delivery condition at the manufacturers discretion.</p> <p>3) If ordered and delivered in the condition N this shall be indicated in the inspection document.</p>		

7.3 Chemical composition

7.3.1 The chemical composition determined by ladle analysis shall comply with the values of table 2.

The upper limits applicable for the product analysis are given in table 3.

7.3.2 For the steel grades S235JR, S235J0, S235J2G3, S235J2G4, S355J0, S355J2G3, S355J2G4, S355K2G3 and S355K2G4 the following additional chemical requirement can be agreed at the time of the enquiry and order:

-- Copper-content between 0,25 % and 0,40 %.

Option 4.

7.3.3 The following additional requirements can be agreed at the time of the enquiry and order:

7.3.3.1 -- a maximum carbon equivalent value, based on the ladle analysis, as given in table 4 shall apply. The carbon equivalent value shall be determined using the following formula:

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

When a maximum carbon equivalent value has been agreed the content of the elements in the carbon equivalent value formula shall be reported in the inspection document.

Option 5.

7.3.3.2 -- for the steel grades S355J0, S355J2G3, S355J2G4, S355K2G3 and S355K2G4 the recording in the inspection documents of the Cr, Cu, Mo, Nb, Ni, Ti and V content (ladle analysis).

Option 6.

7.3.3.3 -- for the steel grades S355J0, S355J2G3, S355J2G4, S355K2G3 and S355K2G4 a maximum content of 0,18 % C ladle analysis or 0,20 % C product analysis for thicknesses ≤ 30 mm if the products contain more than 0,02 % Nb or 0,02 % Ti or 0,03 % V ladle analysis or 0,03 % Nb or 0,04 % Ti or 0,05 % V product analysis.

Option 7.

7.4 Mechanical properties

7.4.1 General

7.4.1.1 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 relevant requirements of tables 5 and 6.

7.4.1.2 For products ordered and supplied in the normalized or normalized rolled condition the mechanical properties shall comply with tables 5 and 6 in the delivered condition as well as after normalizing by heat treatment after delivery.

For wire rod the mechanical properties according to tables 5 and 6 apply to normalized reference test pieces.

NOTE: Stress relief annealing at more than 580 °C or for over 1 hour may lead to a deterioration of the 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.

7.4.1.3 For flat products the nominal thickness applies. For long products of irregular section the nominal thickness of that part from which the samples are taken applies (see Annex A).

7.4.1.4 For flat products of quality J2G3 and K2G3 supplied as-rolled for normalizing by the purchaser the samples shall be normalized. The values obtained from the normalized samples shall comply with this European Standard.

NOTE: The results of these tests do not represent the properties of the supplied products but indicate the properties which may be achieved after correct normalizing.

7.4.2 Impact test

7.4.2.1 If the nominal product thickness is not sufficient for the preparation of full size impact test pieces, test pieces of smaller width shall be taken (see 8.6.3.3) and the applicable values shall be taken from figure 1.

Impact tests are not required for nominal thickness < 6 mm.

7.4.2.2 For products of quality J2G3, J2G4, K2G3 and K2G4 with nominal thickness < 6 mm the ferritic grain size shall be ≥ 6 , verified by the method as described in EURONORM 103, if specified at the time of enquiry and order.
Option 8.

7.4.2.3 When aluminium is used as the grain refining element, the grain size requirement shall be deemed to be fulfilled if on ladle analysis the aluminium content is not less than 0,020 % total aluminium or alternatively, 0,015 % acid soluble aluminium. In this case verification of the grain size is not required.

7.4.2.4 The impact properties of quality JR products are verified by test only when specified at the time of the enquiry and order.
Option 9.

7.4.3 Improved deformation properties perpendicular to the surface

If agreed at the time of the order products of quality J2G3, J2G4, K2G3 and K2G4 shall comply with the improved deformation properties perpendicular to the surface of EN 10164.
Option 10.

7.5 Technological properties

7.5.1 Weldability

7.5.1.1 The steels specified in this European Standard do not have unlimited suitability for the various welding processes, since the behaviour of a steel during and after welding depends not only on the material but also on the dimensions and shape and on the manufacturing and service conditions of the components.

7.5.1.2 There is no information concerning the weldability of the steel grades S185, E295, E335 and E360 available as no requirements are specified concerning the chemical composition.

7.5.1.3 Steels of the qualities JR, JO, J2G3, J2G4, K2G3 and K2G4 are generally suitable for welding, by all welding processes. The weldability increases for each grade from quality JR to K2.

For S235JR killed steels are preferable to rimmed steels particularly if segregation zones could be encountered during welding.

NOTE 1: With increasing product thickness, increasing strength level and increasing carbon equivalent value the occurrence of cold cracking in the welded zone forms the main risk. Cold cracking is caused by the following factors in combination:

- the amount of diffusible hydrogen in the weld metal;
- a brittle structure of the heat affected zone;
- significant tensile stress concentrations in the welded joint.

NOTE 2: When using recommendations as laid down, for example in ECSC IC 2⁵⁾ or any relevant national standard, the recommended welding conditions and the various welding ranges of the steel grades can be determined depending on the product thickness, the applied welding energy, the design requirements, the electrode efficiency, the welding process and the weld metal properties.

5) Will be transformed into EN 1011 "Recommendations for arc welding of ferritic steels".

7.5.2 Hot forming

Only products ordered and supplied in the normalized or normalized rolled condition shall comply with the requirements of tables 5 and 6 if hot forming is carried out after delivery (see 7.4.1.2).

7.5.3 Cold formability

Qualities suitable for cold forming shall be designated by the symbol C when ordering (see 6.2.2).

7.5.3.1 Flangeability

If specified at the time of the enquiry and order, plate, sheet, strip and wide flats with a nominal thickness ≤ 20 mm shall be suitable for flanging without cracking with the minimum bend radii given in table 8. The grades and qualities to which this applies are given in table 7.
Option 18.

7.5.3.2 Roll forming

If specified at the time of the enquiry and order plate and strip with a nominal thickness ≤ 8 mm shall be suitable for the production of sections by cold rolling (for example according to EURONORM 162). The suitability is applicable for bend radii given in table 9. The grades and qualities concerned are given in table 7.
Option 19.

NOTE: All grades and qualities suitable for roll forming are also suitable for the manufacture of cold-finished square and rectangular hollow sections.

7.5.3.3 Drawing of bars

If specified at the time of the enquiry and order, bars shall be suitable for cold drawing. The grades and qualities to which this applies are given in table 7.
Option 23.

7.5.4 Other requirements

At the time of enquiry and order the suitability and the relevant product quality requirements for hot-dip zinc-coating or enamelling can be agreed.
Option 11.

If agreed at the time of the enquiry and order the material shall be suitable for splitting of heavy sections.
Option 24.

7.6 Surface finish

7.6.1 Strip

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

7.6.2 Plates, wide flats and sections

EN 10163 part 1 - 3 applies for the permissible surface discontinuities and for the repair of surface defects by grinding and/or welding.

8 Inspection and testing

8.1 General

8.1.1 The products can be supplied with inspection and testing with respect to their compliance with the requirements of this European Standard.

8.1.2 If inspection and testing is required the purchaser shall specify at the time of enquiry and order:

-- the type of inspection and testing (specific or non-specific) (see EN 10021);

-- the type of the inspection document (see 8.10).

See 4.1 e) and option 12.

Products of steel S185 shall only be submitted to non-specific inspection and testing.

8.1.3 Specific inspection and testing shall be carried out according to the requirements of 8.2 to 8.9.

8.1.4 Unless otherwise agreed at the time of the enquiry and order inspection of surface condition and dimensions shall be carried out by the manufacturer.

Option 13.

8.2 Specific inspection and testing

8.2.1 If an inspection document for specific inspection and testing is required the following shall be carried out:

-- for all products the tensile test;

-- for all products of quality J0, J2G3, J2G4, K2G3 and K2G4 the impact test.

8.2.2 At the time of enquiry and order the following additional tests can be agreed:

a) for all products of quality JR the impact test (see 7.4.2.4);

Option 9.

b) the product analysis if the products are delivered per cast (see 8.5.2).

Option 15.

8.3 Sampling

8.3.1 The verification of the mechanical properties shall be carried out:

- by lot or by cast as specified at the time of the enquiry and order for the quality JR and the steel grades E295, E335 and E360; option 14;
- by cast for the qualities J0, J2G3, J2G4, K2G3 and K2G4.

8.3.2 If it is specified at the time of the enquiry and order that sampling should be by lot, it is permissible for the manufacturer to substitute sampling by cast, if the products are delivered by cast.

8.4 Test units

8.4.1 The test unit shall contain products of the same form and grade and of the same thickness range as specified in table 5 for the yield strength and shall be:

- by lot : 20 tonnes or part thereof,
- by cast: 40 tonnes or part thereof,
60 tonnes or part thereof for heavy sections with a mass > 100 kg/m.

8.4.2 If specified at the time of the enquiry and order for flat products of quality J2G3, J2G4, K2G3 and K2G4 the impact test only or the impact test and the tensile test shall be carried out on each parent plate or coil.
Option 20.

8.5 Verification of chemical composition

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

8.5.2 Product analysis shall be carried out if specified at the time of the enquiry and order. The purchaser shall specify the number of samples and the elements to be determined.
Option 15.

8.6 Mechanical tests

8.6.1 Number of samples

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

- one sample for tensile testing (see 8.2.1),
- one sample sufficient for one set of six impact test pieces for quality J0, J2G3, J2G4, K2G3 and K2G4 and if required for quality JR (see 8.2.1 and 8.2.2 a).

8.6.2 Position of samples (see Annex A)

The samples shall be taken from the thickest product in the test unit except for flat products of quality J2G3 and K2G3, for which the samples

are taken from any product of the test unit.

8.6.2.1 For plates, sheet, wide strip and wide flats the samples shall be taken so that the axes of the test pieces are approximately midway between the edge and centre line of the products.

For wide strip and wire rod 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 at an adequate distance from the end and at one third of the width.

8.6.2.2 For long products EURONORM 18 applies (see Annex A).

8.6.2.3 For semi-finished products, when the order specifies the requirement for testing, in addition to chemical composition, samples with a side or diameter ≤ 20 mm are prepared by hot forming from the full product section and subsequently normalized.
Option 27.

8.6.3 Selection and preparation of test pieces

8.6.3.1 General

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

8.6.3.2 Tensile test pieces

The requirements of EN 10002-1 as appropriate shall apply.

Test pieces may be non-proportional but in cases of dispute proportional test pieces having a gauge length $L_0 = 5,65 \sqrt{S_0}$ shall be used (see 8.7.2.1).

For flat products with a nominal thickness < 3 mm the test pieces shall always have a gauge length $L_0 = 80$ mm and a width of 20 mm (test piece 2 EN 10002-1 Annex A).

For bars round test pieces are commonly used but other forms are not prohibited (see EN 10002-1).

8.6.3.3 Impact test pieces

Impact V-notch test pieces shall be cut parallel to the principal direction of rolling. The test pieces shall be machined and prepared in accordance with EN 10045-1. In addition the following requirements apply:

- a) for nominal thicknesses > 12 mm, standard 10 mm x 10 mm test pieces shall be machined in such a way that one side is not further away than 2 mm from a rolled surface;
- b) for nominal thicknesses ≤ 12 mm, when test pieces with reduced widths are used, the minimum width shall be ≥ 5 mm.

8.6.3.4 Chemical analysis samples

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

8.7 Test methods

8.7.1 Chemical analysis

For the determination of the chemical composition the corresponding European Standard or EURONORMS (see footnote 2 of clause 2) shall apply in cases of dispute.

8.7.2 Mechanical tests

Mechanical tests shall be carried out in the temperature range 10°C - 35°C, except where a specific temperature is specified for impact tests.

8.7.2.1 Tensile tests

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

For the specified yield strength in table 5 the upper yield strength (R_{eH}) shall be determined.

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

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

8.7.2.2 Impact tests

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

The average value of the three test results shall meet the specified requirement. One individual value may be below the minimum average value specified, provided that it is not less than 70 % of that value.

Three additional test pieces shall be taken from the same sample in accordance with 8.6.1 and tested in any one of the following cases:

- if the average of three impact values is lower than the minimum average value specified;
- if the average value meets the specified requirement, but two individual values are lower than the minimum average value specified;
- if any one value is lower than 70 % of the minimum average value specified.

The average value of the six tests shall be not less than the minimum average value specified. Not more than two of the individual values may be lower than the minimum average value specified and not more than one may be lower than 70 % of this value.

8.8 Retests and resubmission for testing

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

In the case of strip and wire rod, 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.

8.9 Internal defects

EN 10021 shall apply for testing for internal defects.

8.10 Inspection documents

8.10.1 For steel S185, only certificates of compliance with the order shall be supplied when specified at the time of the enquiry and order.

8.10.2 For all other steels if agreed and specified at the time of the enquiry and order one of the documents specified in EN 10204 shall be supplied. In these documents the information groups A, B and Z and the code numbers C01-C03, C10-C13, C40-C43 and C71-C92 according to EURONORM 168 shall be included.
See 4.1 e) and option 12.

9 Marking of flat and long products

9.1 Unless otherwise agreed at the time of the enquiry and order, products shall be marked by painting, stamping, durable adhesive labels or attached tags with the following:

- the grade, indicated by its abridged designation (e.g. S275J0);
 - a number by which the cast can be identified (if inspection is by cast);
 - the manufacturers name or trademark.
- Option 16.

9.2 Marking shall be at a position close to one end of each product or on the end cut face at the manufacturers discretion.

9.3 It is permissible for light products to be supplied in securely tied bundles. In this case the marking shall be on a label attached to the bundle or on the top product of the bundle.

10 Complaints after delivery

EN 10021 shall apply in respect of complaints after delivery and their processing.

11 Options (see 4.2)

11.1 All products

- 1) The steel manufacturing process shall be indicated with the exception of steel S185 (see 7.1.1).
- 2) A special steel manufacturing process is required for qualities J0, J2G3, J2G4, K2G3 and K2G4 (see 7.1.1).
- 3) A special method of deoxidation is required for steel S235JR (see 7.1.2).
- 4) A copper content between 0,25 % and 0,40 % is required (see 7.3.2).
- 5) A maximum carbon equivalent value as given in table 4 is required for the steel grades S235, S275 and S355. (see 7.3.3.1).
- 6) The recording of additional chemical elements in the inspection document for the steel grade S355 is required (see 7.3.3.2).
- 7) A maximum carbon content of 0,18 % ladle analysis is required for thicknesses ≤ 30 mm for the steels S355J0, S355J2 and S355K2 (see 7.3.3.3).
- 8) The grain size shall be verified for products of quality J2G3, J2G4, K2G3 and K2G4 with nominal thickness < 6 mm (see 7.4.2.2).
- 9) The impact properties of quality JR shall be verified by test (see 7.4.2.4, 8.2.2a and table 6).
- 10) Products of quality J2G3, J2G4, K2G3 and K2G4 shall comply with the improved properties perpendicular to the surface of EN 10164 (see 7.4.3).
- 11) The material shall be suitable for hot-dip zinc-coating or enamelling (see 7.5.4).
- 12) Products shall be submitted to inspection and testing and if inspection and testing is required which type and which inspection document is required (see 4.1 e) and 8.1.2).
- 13) Inspection of surface condition and dimensions shall be carried out by the purchaser at the manufacturers works (see 8.1.4).
- 14) The verification of the mechanical properties for the quality JR and the steel grades E295, E335 and E360 shall be carried out by lot or by cast (see 4.1 f) and 8.3.1).
- 15) Product analysis shall be carried out and if so the number of samples and the elements to be determined (see 8.5.2).
- 16) Specific marking is required (see 9.1).

11.2 Flat products

- 17) The delivery condition N is required for the steel grades S185, E295, E335 and E360 and the steel grades S235, S275 and S355 of quality JR and JO (see 7.2.2.1).
- 18) Sheet, plate, strip and wide flats with a nominal thickness ≤ 20 mm shall be suitable for flanging without cracking (see 7.5.3.1).
- 19) Plate and strip with nominal thickness ≤ 8 mm shall be suitable for the production of sections by cold rolling with bend radii given in table 9 (see 7.5.3.2).
- 20) For flat products of quality J2G3, J2G4, K2G3 and K2G4 the impact test only or the impact test and the tensile test shall be carried out on each parent plate or coil (see 8.4.2).
- 21) For flat products of nominal thickness > 30 mm a round test piece shall be used for the tensile test (see figure A.3).

11.3 Long products

- 22) The delivery condition N is required for the steel grades S185, E295, E335 and E360 and the steel grades S235, S275 and S355 of quality JR, JO, J2G3 and K2G3 (see 7.2.3.1).
- 23) Bars shall be suitable for cold drawing (see 7.5.3.3).
- 24) Heavy sections shall be suitable for splitting (see 7.5.4).
- 25) The maximum carbon content shall be provided for sections with nominal thickness > 100 mm (see table 2 and 3).
- 26) The minimum impact values shall be provided for sections with a nominal thickness > 100 mm (see table 6).

11.4 Semi-finished products

- 27) Semi-finished products shall be tested (see 8.6.2.3).

Table 2: Chemical composition of the ladle analysis for flat and long products ¹⁾

Designation		Method of deoxidation	Sub-group ⁴⁾	C in % max. for nominal product thickness in mm			Mn % max.	Si % max.	P % max.	S % max.	²⁻³⁾ N % max.	
According to EN 10027-1 and ECSS IC 10	According to EN 10027-2			≤ 16	> 16 ≤ 40	> 40 ⁵⁾						
S185 ⁶⁾	1.0035	opt.	BS	-	-	-	-	-	-	-	-	-
S235JR ⁶⁾	1.0037	opt.	BS	0,17	0,20	-	1,40	-	0,045	0,045	0,009	
S235JRG1 ⁶⁾	1.0036	FU	BS	0,17	0,20	-	1,40	-	0,045	0,045	0,007	
S235JRG2	1.0038	FN	BS	0,17	0,17	0,20	1,40	-	0,045	0,045	0,009	
S235J0	1.0114	FN	QS	0,17	0,17	0,17	1,40	-	0,040	0,040	0,009	
S235J2G3	1.0116	FF	QS	0,17	0,17	0,17	1,40	-	0,035	0,035	-	
S235J2G4	1.0117	FF	QS	0,17	0,17	0,17	1,40	-	0,035	0,035	-	
S275JR	1.0044	FN	BS	0,21	0,21	0,22	1,50	-	0,045	0,045	0,009	
S275J0	1.0143	FN	QS	0,18	0,18	0,18 ⁷⁾	1,50	-	0,040	0,040	0,009	
S275J2G3	1.0144	FF	QS	0,18	0,18	0,18 ⁷⁾	1,50	-	0,035	0,035	-	
S275J2G4	1.0145	FF	QS	0,18	0,18	0,18 ⁷⁾	1,50	-	0,035	0,035	-	
S355JR	1.0045	FN	BS	0,24	0,24	0,24	1,60	0,55	0,045	0,045	0,009	
S355J0 ⁶⁾	1.0553	FN	QS	0,20	0,20 ⁶⁾	0,22	1,60	0,55	0,040	0,040	0,009	
S355J2G3 ⁶⁾	1.0570	FF	QS	0,20	0,20 ⁶⁾	0,22	1,60	0,55	0,035	0,035	-	
S355J2G4 ⁶⁾	1.0577	FF	QS	0,20	0,20 ⁶⁾	0,22	1,60	0,55	0,035	0,035	-	
S355K2G3 ⁶⁾	1.0595	FF	QS	0,20	0,20 ⁶⁾	0,22	1,60	0,55	0,035	0,035	-	
S355K2G4 ⁶⁾	1.0596	FF	QS	0,20	0,20 ⁶⁾	0,22	1,60	0,55	0,035	0,035	-	
E295	1.0050	FN	BS	-	-	-	-	-	0,045	0,045	0,009	
E335	1.0060	FN	BS	-	-	-	-	-	0,045	0,045	0,009	
E360	1.0070	FN	BS	-	-	-	-	-	0,045	0,045	0,009	

1) See 7.3.

2) It is permissible to exceed the specified values provided that for each increase of 0,001 % N the P max. content will be reduced by 0,005 %; the N content of the ladle analysis, however, shall not be more than 0,012 %.

3) The max. value for nitrogen does not apply if the chemical composition shows a minimum total Al content of 0,020 % or if sufficient other N binding elements are present. The N binding elements shall be mentioned in the inspection document.

4) BS = base steel; QS = quality steel.

5) For sections with nominal thickness > 100 mm the C content by agreement. Option 25.

6) Only available in nominal thickness ≤ 25 mm.

7) For nominal thickness > 150 mm: C = 0,20 % max..

8) See 7.3.3.2 and 7.3.3.3.

9) For nominal thickness > 30 mm and for grades suitable for cold roll forming (see 7.5.3.2): C = 0,22 % max..

Table 3: Chemical composition of the product analysis based on table 2 ¹⁾

Designation		Method of deoxidation	Sub-group ⁴⁾	C in % max. for nominal product thickness in mm			Mn % max.	Si % max.	P % max.	S % max.	N % max. ²⁻³⁾
According EN 10027-1 and ECSS IC 10	According EN 10027-2			≤ 16	> 16 ≤ 40	> 40 ⁵⁾					
S185 ⁶⁾	1.0035	opt.	BS	-	-	-	-	-	-	-	-
S235JR ⁶⁾	1.0037	opt.	BS	0,21	0,25	-	1,50	-	0,055	0,055	0,011
S235JRG1 ⁶⁾	1.0036	FU	BS	0,21	0,25	-	1,50	-	0,055	0,055	0,009
S235JRG2	1.0038	FN	BS	0,19	0,19	0,23	1,50	-	0,055	0,055	0,011
S235J0	1.0114	FN	QS	0,19	0,19	0,19	1,50	-	0,050	0,050	0,011
S235J2G3	1.0116	FF	QS	0,19	0,19	0,19	1,50	-	0,045	0,045	-
S235J2G4	1.0117	FF	QS	0,19	0,19	0,19	1,50	-	0,045	0,045	-
S275JR	1.0044	FN	BS	0,24	0,24	0,25	1,60	-	0,055	0,055	0,011
S275J0	1.0143	FN	QS	0,21	0,21	0,21 ⁷⁾	1,60	-	0,050	0,050	0,011
S275J2G3	1.0144	FF	QS	0,21	0,21	0,21 ⁷⁾	1,60	-	0,045	0,045	-
S275J2G4	1.0145	FF	QS	0,21	0,21	0,21 ⁷⁾	1,60	-	0,045	0,045	-
S355JR	1.0045	FN	BS	0,27	0,27	0,27	1,70	0,60	0,055	0,055	0,011
S355J0 ⁶⁾	1.0553	FN	QS	0,23	0,23 ⁸⁾	0,24	1,70	0,60	0,050	0,050	0,011
S355J2G3 ⁶⁾	1.0570	FF	QS	0,23	0,23 ⁸⁾	0,24	1,70	0,60	0,045	0,045	-
S355J2G4 ⁶⁾	1.0577	FF	QS	0,23	0,23 ⁸⁾	0,24	1,70	0,60	0,045	0,045	-
S355K2G3 ⁶⁾	1.0595	FF	QS	0,23	0,23 ⁸⁾	0,24	1,70	0,60	0,045	0,045	-
S355K2G4 ⁶⁾	1.0596	FF	QS	0,23	0,23 ⁸⁾	0,24	1,70	0,60	0,045	0,045	-
E295	1.0050	FN	BS	-	-	-	-	-	0,055	0,055	0,011
E335	1.0060	FN	BS	-	-	-	-	-	0,055	0,055	0,011
E360	1.0070	FN	BS	-	-	-	-	-	0,055	0,055	0,011

- 1) See 7.3.
- 2) It is permissible to exceed the specified values provided that for each increase of 0,001 % N the P max. content will be reduced by 0,005 %; the N content of the product analysis, however, shall not be more than 0,014 %.
- 3) The max. value for nitrogen does not apply if the chemical composition shows a minimum total Al content of 0,020 % or if sufficient other N binding elements are present. The N binding elements shall be mentioned in the inspection document.
- 4) BS = base steel; QS = quality steel.
- 5) For sections with nominal thickness > 100 mm the C content by agreement.
- Option 25.
- 6) Only available in nominal thickness ≤ 25 mm.
- 7) For nominal thickness > 150 mm: C = 0,23 % max..
- 8) See 7.3.3.2. and 7.3.3.3.
- 9) For nominal thickness > 30 mm and for grades suitable for cold roll forming (see 7.5.3.2): C = 0,24 % max..

Table 4: Maximum CEV based on the ladle analysis, if agreed at the time of the enquiry and order Option 5.

Designation		Method of deoxidation	Sub-group ¹⁾	Maximum CEV for nominal product thickness in mm		
According to EN 10027-1 and ECIS IC 10	According to EN 10027-2			≤ 40	> 40 ≤ 150	> 150 ≤ 250
S235JR ²⁾	1.0037	opt.	BS	0,35	-	-
S235JRG1 ²⁾	1.0036	FU	BS	0,35	-	-
S235JRG2	1.0038	FN	BS	0,35	0,38	0,40
S235J0	1.0114	FN	QS	0,35	0,38	0,40
S235J2G3	1.0116	FF	QS	0,35	0,38	0,40
S235J2G4	1.0117	FF	QS	0,35	0,38	0,40
S275JR	1.0044	FN	BS	0,40	0,42	0,44
S275J0	1.0143	FN	QS	0,40	0,42	0,44
S275J2G3	1.0144	FF	QS	0,40	0,42	0,44
S275J2G4	1.0145	FF	QS	0,40	0,42	0,44
S355JR	1.0045	FN	BS	0,45	0,47	0,49
S355J0	1.0553	FN	QS	0,45	0,47	0,49
S355J2G3	1.0570	FF	QS	0,45	0,47	0,49
S355J2G4	1.0577	FF	QS	0,45	0,47	0,49
S355K2G3	1.0595	FF	QS	0,45	0,47	0,49
S355K2G4	1.0596	FF	QS	0,45	0,47	0,49

1) BS = base steel; QS = quality steel.
2) Only available in nominal thickness ≤ 25 mm.

Table 5 : Mechanical properties for flat and long products

Designation	Method of deoxidation	Sub-group ¹⁾	Minimum yield strength R_{m1} in N/mm ² ¹⁾						Tensile strength R_m in N/mm ² ¹⁾													
			Nominal thickness in mm						Nominal thickness in mm													
			≤ 16	> 16 ≤ 40	> 40 ≤ 63	> 63 ≤ 80	> 80 ≤ 100	> 100 ≤ 150	> 150 ≤ 200	> 200	< 3	≥ 3 ≤ 100	> 100 ≤ 150	> 150 ≤ 250								
According to EN 10027-1 and ECSS IC 10																						
S185 ³⁾	opt.	BS	185	175											310-540	290-510						
S235JR ²⁾	opt.	BS	235	225											360-510	340-470						
S235JRG1 ²⁾	FU	BS	235	225											360-510	340-470						
S235JRG2	FN	BS	235	225	215	215	215	215	185	195	185	175			360-510	340-470	340-470					320-470
S235JO	FN	QS	235	225	215	215	215	215	185	195	185	175			360-510	340-470	340-470					320-470
S235J2G3	FF	QS	235	225	215	215	215	215	185	195	185	175			360-510	340-470	340-470					320-470
S235J2G4	FF	QS	235	225	215	215	215	215	185	195	185	175			360-510	340-470	340-470					320-470
S275JR	FN	BS	275	265	255	245	235	225	215	205					430-580	410-560	400-540					380-540
S275JO	FN	QS	275	265	255	245	235	225	215	205					430-580	410-560	400-540					380-540
S275J2G3	FF	QS	275	265	255	245	235	225	215	205					430-580	410-560	400-540					380-540
S275J2G4	FF	QS	275	265	255	245	235	225	215	205					430-580	410-560	400-540					380-540
S355JR	FN	BS	355	345	335	325	315	295	285	275					510-660	490-630	470-630					450-630
S355JO	FN	QS	355	345	335	325	315	295	285	275					510-660	490-630	470-630					450-630
S355J2G3	FF	QS	355	345	335	325	315	295	285	275					510-660	490-630	470-630					450-630
S355J2G4	FF	QS	355	345	335	325	315	295	285	275					510-660	490-630	470-630					450-630
S355K2G3	FF	QS	355	345	335	325	315	295	285	275					510-660	490-630	470-630					450-630
S355K2G4	FF	QS	355	345	335	325	315	295	285	275					510-660	490-630	470-630					450-630
E295 ¹⁾	FN	BS	295	285	275	265	255	245	235	225					490-660	470-610	450-610					440-610
E335 ¹⁾	FN	BS	335	325	315	305	295	275	265	255					590-770	570-710	550-710					540-710
E360 ¹⁾	FN	BS	360	355	345	335	325	305	295	285					690-900	670-830	650-830					640-830

1) The values in the table apply to longitudinal test pieces (l) for the tensile test. For plate, strip and wide flats with widths ≥ 600 mm transverse test pieces (t) are applicable.
 2) BS - base steel; QS - quality steel.
 3) Only available in nominal thicknesses ≤ 25 mm.
 4) These steels are normally not used for channels, angles and sections.

(continued)

Table 5 (concluded)

Designation	Method of deoxidation	Sub-group ²⁾	Position of test pieces ¹⁾	Minimum percentage elongation ¹⁾											
				$L_0 = 80 \text{ mm}$						$L_0 = 5,65 \sqrt{S_0}$					
				Nominal thickness in mm			Nominal thickness in mm			Nominal thickness in mm			Nominal thickness in mm		
According to EN 10027-1 and ECIS IC 10				≤ 1	> 1 $\leq 1,5$	$> 1,5$ ≤ 2	> 2 $\leq 2,5$	$> 2,5$ < 3	≥ 3 ≤ 40	> 40 ≤ 63	> 63 ≤ 100	> 100 ≤ 150	> 150 ≤ 250		
S185 ³⁾	opt.	BS	l t	10 8	11 9	12 10	13 11	14 12	18 16	- -	- -	- -	- -	- -	
S235JR ³⁾	opt.	BS	l	17	18	19	20	21	26	25	24	22	21		
S235JRG1 ³⁾	FU	BS													
S235JRG2	FN	BS													
S235JO	FN	OS													
S235J2G3	FF	OS	t	15	16	17	18	19	24	23	22	22	21		
S235J2G4	FF	OS													
S275JR	FN	BS	l	14	15	16	17	18	22	21	20	18	17		
S275JO	FN	OS													
S275J2G3	FF	OS	t	12	13	14	15	16	20	19	18	18	17		
S275J2G4	FF	OS													
S355JR	FN	BS	l	14	15	16	17	18	22	21	20	18	17		
S355JO	FN	OS													
S355J2G3	FF	OS													
S355J2G4	FF	OS													
S355K2G3	FF	OS	t	12	13	14	15	16	20	19	18	18	17		
S355K2G4	FF	OS													
E295 ⁴⁾	FN	BS	l t	12 10	13 11	14 12	15 13	16 14	20 18	19 17	18 16	16 15	15 14		
E335 ⁴⁾	FN	BS	l t	8 6	9 7	10 8	11 9	12 10	16 14	15 13	14 12	12 11	11 10		
E360 ⁴⁾	FN	BS	l t	4 3	5 4	6 5	7 6	8 7	11 10	10 9	9 8	8 7	7 6		

1) The values in the table apply to longitudinal test pieces (l) for the tensile test. For plate, strip and wide flats with widths $\geq 600 \text{ mm}$ transverse test pieces (t) are applicable.
 2) BS = base steel; OS = quality steel.
 3) Only available in nominal thickness $\leq 25 \text{ mm}$.
 4) These steels are normally not used for channels, angles and sections.

Table 6: Mechanical properties; impact strength KV longitudinal for flat and long products ¹⁾

Designation		Method of deoxidation	Sub-group ²⁾	Temperature °C	Minimum energy (J) Nominal thickness in mm	
According to EN 10027-1 and ECISS IC 10	According to EN 10027-2				> 10 ³⁾ ≤ 150	> 150 ³⁾ ≤ 250
S185 ⁴⁾	1.0035	opt.	BS	-	-	-
S235JR ⁴⁾ ⁵⁾	1.0037	opt.	BS	20	27	-
S235JRG1 ⁴⁾ ⁵⁾	1.0036	FU	BS	20	27	-
S235JRG2 ⁵⁾	1.0038	FN	BS	20	27	23
S235J0	1.0114	FN	QS	0	27	23
S235J2G3	1.0116	FF	QS	- 20	27	23
S235J2G4	1.0117	FF	QS	- 20	27	23
S275JR ⁵⁾	1.0044	FN	BS	20	27	23
S275J0	1.0143	FN	QS	0	27	23
S275J2G3	1.0144	FF	QS	- 20	27	23
S275J2G4	1.0145	FF	QS	- 20	27	23
S355JR ⁵⁾	1.0045	FN	BS	20	27	23
S355J0	1.0553	FN	QS	0	27	23
S355J2G3	1.0570	FF	QS	- 20	27	23
S355J2G4	1.0577	FF	QS	- 20	27	23
S355K2G3	1.0595	FF	QS	- 20	40	33
S355K2G4	1.0596	FF	QS	- 20	40	33
E295	1.0050	FN	BS	-	-	-
E335	1.0060	FN	BS	-	-	-
E360	1.0070	FN	BS	-	-	-

1) For subsize test pieces figure 1 applies.
2) BS = base steel; QS = quality steel.
3) For sections with a nominal thickness > 100 mm the values shall be agreed.
Option 26.
4) Only available in nominal thickness ≤ 25 mm.
5) The impact properties of quality JR products are verified only when specified at the time of the enquiry and order.
Option 9.

Table 7: Technological properties

Designation		Sub-group 1)	Suitability for		
According EN 10027-1 and ECISS IC 10	According EN 10027-2		Cold flanging	Cold roll forming	Cold drawing
S235JRC	1.0120	QS	x	x	x
S235JRG1C	1.0121	QS	x	x	x
S235JRG2C	1.0122	QS	x	x	x
S235J0C	1.0115	QS	x	x	x
S235J2G3C	1.0118	QS	x	x	x
S235J2G4C	1.0119	QS	x	x	x
S275JRC	1.0128	QS	x	x	x
S275J0C	1.0140	QS	x	x	x
S275J2G3C	1.0141	QS	x	x	x
S275J2G4C	1.0142	QS	x	x	x
S355JRC	1.0551	QS	-	-	x
S355J0C	1.0554	QS	x	x	x
S355J2G3C	1.0569	QS	x	x	x
S355J2G4C	1.0579	QS	x	x	x
S355K2G3C	1.0593	QS	x	x	x
S355K2G4C	1.0594	QS	x	x	x
E295GC	1.0533	QS	-	-	x
E335GC	1.0543	QS	-	-	x
E360GC	1.0633	QS	-	-	x

1) QS = quality steel in accordance with EN 10020.

Table 8: Minimum value of the bend radius for cold flanging of flat products

Designation	Bending direction ¹⁾	Minimum recommended inside bend radius for nominal thicknesses in mm													
		> 1 ≤ 1,5	> 1,5 ≤ 2,5	> 2,5 ≤ 3	> 3 ≤ 4	> 4 ≤ 5	> 5 ≤ 6	> 6 ≤ 7	> 7 ≤ 8	> 8 ≤ 10	> 10 ≤ 12	> 12 ≤ 14	> 14 ≤ 16	> 16 ≤ 18	> 18 ≤ 20
S236JRC															
S236JRG1C	t	1,6	2,5	3	5	6	8	10	12	16	20	25	28	36	40
S236JRG2C	l	1,6	2,5	3	6	8	10	12	16	20	25	28	32	40	46
S236JOC															
S236J2G3C															
S236J2G4C															
S275JRC															
S275JOC	t	2	3	4	5	8	10	12	16	20	25	28	32	40	45
S275J2G3C	l	2	3	4	6	10	12	16	20	25	32	36	40	45	50
S275J2G4C															
S355JOC															
S355J2G3C															
S355J2G4C	t	2,5	4	5	6	8	10	12	16	20	25	32	36	45	50
S355K2G3C	l	2,5	4	5	8	10	12	16	20	25	32	36	40	50	63
S355K2G4C															

1) t: transverse to the rolling direction.
l: parallel to the rolling direction.

Table 9: Cold roll forming of flat products

Designation		Minimum recommended inside bend radii for nominal thicknesses (s) in mm ¹⁾	
According to EN 10027-1 and ECISS IC 10	According to EN 10027-2	s ≤ 6 mm	6 < s ≤ 8 mm
S235JRC S235JRG1C S235JRG2C S235J0C S235J2G3C S235J2G4C	1.0120 1.0121 1.0122 1.0115 1.0118 1.0119	1 s	1,5 s
S275JRC S275J0C S275J2G3C S275J2G4C	1.0128 1.0140 1.0141 1.0142	1,5 s	2 s
S355J0C S355J2G3C S355J2G4C S355K2G3C S355K2G4C	1.0554 1.0569 1.0579 1.0593 1.0594	2 s	2,5 s
1) The values are applicable for bend angles ≤ 90°.			

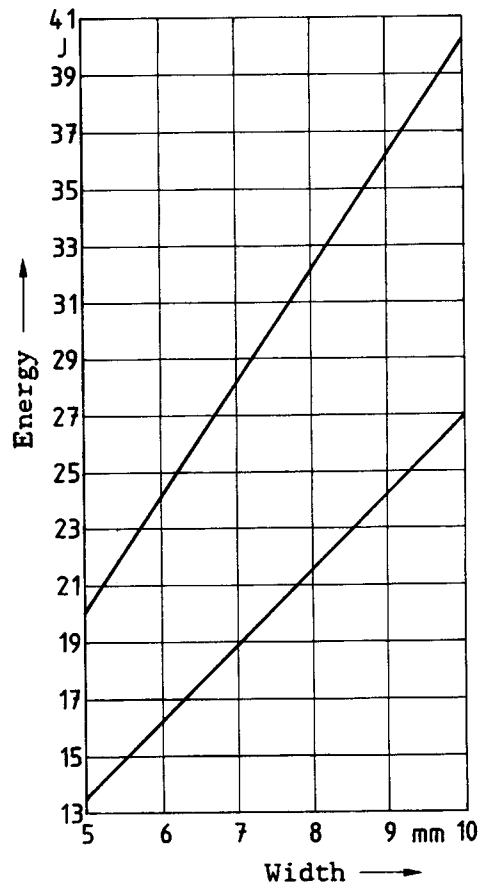


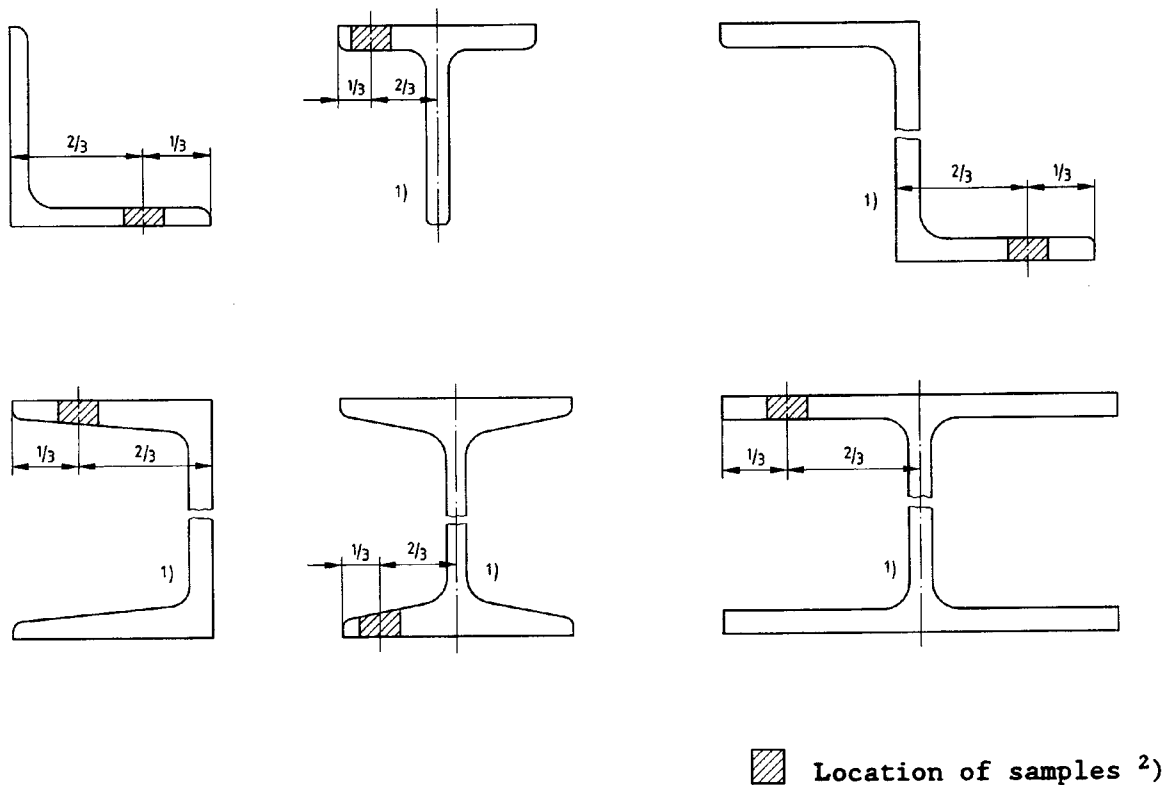
Figure 1: Minimum impact energy values (J) for impact test pieces with a width between 5 mm and 10 mm.

Annex A
(Normative)

Location of samples and test pieces (see EURONORM 18)

The following three categories of products are covered:

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



- 1) By agreement, the sample can be taken from the web, at a quarter of the total height.
- 2) Test pieces are taken from the sample as indicated in figure A.3. For sections with inclined flanges, machining of the inclined surface is permitted in order to make it parallel to the other surface.

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

Dimensions in mm

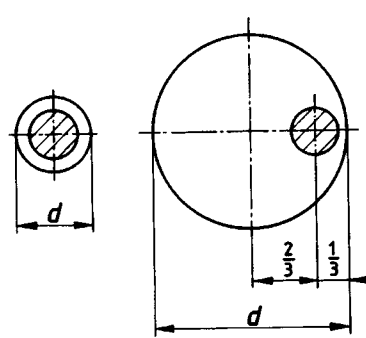
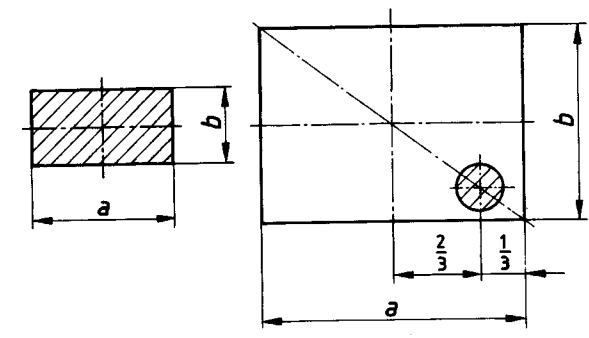
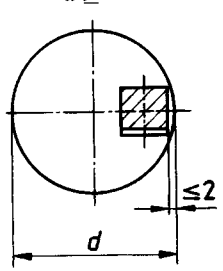
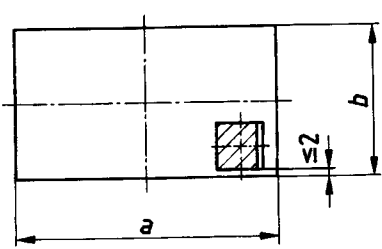
Type of steel	Type of test	Products with round cross-section	Products with rectangular cross-section
Structural steels	Tensile	<p>$d \leq 25^1)$ $d > 25^2)$</p> 	<p>$b \leq 25^1)$ $b > 25^2)$</p> 
	Impact 3)	<p>$d \geq 16$</p> 	<p>$b \geq 12$</p> 
<p>1) For products with small dimensions (d or $b \leq 25$ mm) the test piece, if possible, consists of an unmachined full section of the product.</p> <p>2) For products of diameter or thickness ≤ 40 mm the manufacturer may either apply:</p> <ul style="list-style-type: none"> -- the rules specified for products of diameter or thickness ≤ 25 mm, or -- take the test piece at a location nearer the centre than indicated in the figure. <p>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.</p>			

Figure A.2: Bars and wire (including wire rod)

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	
Tensile 1)	≤ 30			
	> 30	longitudinal	transverse	
Impact 2)	> 12	longitudinal	longitudinal	
<p>1) In case of doubt or dispute, for products of thickness greater than or equal to 3 mm use proportional test pieces of gauge length $L_0 = 5,65 \sqrt{S_0}$. For normal testing, for reasons of economy, test pieces of a constant measuring length may be used provided the result obtained for elongation after breaking is converted by a recognized formula (see, for example, ISO 2566 -- Conversion of elongation values). For products of thickness greater than 30 mm a round test piece may be used if agreed between the parties. Option 21.</p> <p>2) The axis of the notch shall be perpendicular to the surface of the product.</p>				

Figure A.3: Flat products

Annex B (informative)

List of national standards which correspond with EURONORMS referenced

Until the following EURONORMS are transformed into European Standards, they may be either implemented or reference made to the corresponding national standards as listed in table B.1.

Table B.1: EURONORMS with corresponding national standards

EURONORM	Corresponding national standard in				
	Germany	France	United Kingdom	Spain	Italy
17	DIN 59110	NF A 45-051	--	UNE 36-089	UNI 5598
18	--	NF A 03 111	BS 4360	UNE 36-300 UNE 36-400	UNI-EU 18
19	DIN 1025 T5	NF A 45 205	--	UNE 36-526	UNI 5398
24	DIN 1025 T1 DIN 1026	NF A 45 210	BS 4	UNE 36-521 UNE 36-522	UNI 5679 UNI 5680
53	DIN 1025 T2 DIN 1025 T3 DIN 1025 T4	NF A 45 201	BS 4	UNE 36-527 UNE 36-528 UNE 36-529	UNI 5397
54	DIN 1026	NF A 45 007	BS 4	UNE 36-525	UNI-EU 54
56	DIN 1028	NF A 45 009 1)	BS 4848	UNE 36-531	UNI-EU 56
57	DIN 1029	NF A 45 010 1)	BS 4848	UNE 36-532	UNI-EU 57
58	DIN 1017 T1	NF A 45 005 1)	BS 4360	UNE 36-543	UNI-EU 58
59	DIN 1014 T1	NF A 45 004 1)	BS 4360	UNE 36-542	UNI-EU 59
60	DIN 1013 T1	NF A 45 003 1)	BS 4360	UNE 36-541	UNI-EU 60
61	DIN 1015	NF A 45 006 1)	BS 970	UNE 36-547	UNI 7061
65	DIN 59 130	NF A 45 075 1)	BS 3111	UNE 36-546	UNI 7356
66	DIN 1018	--	--	--	UNI 6630
91	DIN 59 200	NF A 46 012	BS 4360	--	UNI-EU 91
103	DIN 50 601	NF A 04 102	BS 4490	UNE 7-280	--
162	DIN 17 118 DIN 59 413	NF A 37 101	BS 2994	UNE 36-570	UNI 7344
168	--	NF A 03 116	BS 4360	UNE 36-800	UNI-EU 168
ECSC IC 2	SEW 088	NF A 36 000	BS 5135	--	--

1) NF A 45 001 and NF A 45 101 shall be added for the tolerances.

(continued)

Table B.1 (concluded)

EURONORM	Corresponding national standard in				
	Belgium	Portugal	Sweden	Austria	Norway
17	NBN 524	NP 330			
18	NBN A 03-001	NP-2451	SS 11 01 20 SS 11 01 05	--	NS 10 005 NS 10 006
19	NBN 533	NP-2116	SS 21 27 40	M 3262	--
24	NBN 632-01	--	SS 21 27 25 SS 21 27 35	M 3261	NS 911
53	NBN 633	NP-2117	SS 21 27 50 SS 21 27 51 SS 21 27 52	--	NS 1907 NS 1908
54	NBN A 24-204	NP-338	--	M 3260	--
56	NBN A 24-201	NP-335	SS 21 27 11	M 3246	NS 1903
57	NBN A 24-202	NP-336	SS 21 27 12	M 3247	NS 1904
58	NBN A 34-201	--	SS 21 21 50	M 3230	NS 1902
59	NBN A 34-202	NP-333 NP-334	SS 21 27 25	M 3226	NS 1901
60	NBN A 34-203	NP-331	SS 21 25 02	M 3221	NS 1900
61	NBN A 34-204	--	--	M 3227 M 3228	--
65	NBN A 24-206	--	--	M 3223	--
66	--	--	--	--	--
91	NBN A 43-301	--	SS 21 21 50	M 3231	--
103	NBN A 14-101	NP-1787	--	--	--
162	NBN A 02-002	--	--	M 3316	--
168	--	--	SS 11 00 12	--	--
ECSC IC 2	--	--	SS 06 40 25	--	--

Annex C (informative)

List of corresponding former national designations

Table C.1: List of corresponding former designations

Designation	Equivalent former designations in												
	According EN 10027-1 and ECIS IC 10	According EN 10027-2	According EN 10025:1990	Germany	France	United Kingdom	Spain	Italy	Belgium	Sweden	Portugal	Austria	Norway
S185	1.0035	Fe 310-0	St 33	A 33	A 310-0	Fe 320	A 320	13 00-00	Fe 310-0	St 320			
S235JR	1.0037	Fe 360 B	St 37-2	E 24-2	AE 235 B-FU	Fe 360 B	AE 235-B	13 11-00	Fe 360-B	USI 360 B	NS 12 120		
S235JRG1	1.0036	Fe 360 BFN	USI 37-2		AE 235 B-FN					RSI 360 B	NS 12 122		
S235JRG2	1.0038	Fe 360 BFN	RSI 37-2		AE 235 C	40 B	AE 235-C	13 12-00	Fe 360-C	St 360 C	NS 12 123		
S235J0	1.0114	Fe 360 C	St 37-3 U	E 24-3	AE 235 C	40 C	AE 235-D		Fe 360-D	St 360 CE	NS 12 124		
S235J2G3	1.0116	Fe 360 D1	St 37-3 N	E 24-4	AE 235 D	40 D			Fe 360-D	St 360 D	NS 12 124		
S235J2G4	1.0117	Fe 360 D2	..										
S275JR	1.0044	Fe 430 B	St 44-2	E 28-2	AE 275 B	43 B	AE 255-B	14 12-00	Fe 430-B	St 430 B	NS 12 142		
S275J0	1.0143	Fe 430 C	St 44-3 U	E 28-3	AE 275 C	43 C	AE 255-C		Fe 430-C	St 430 C	NS 12 143		
S275J2G3	1.0144	Fe 430 D1	St 44-3 N	E 28-4	AE 275 D	43 D	AE 255-D	14 14-00	Fe 430-D	St 430 D	NS 12 143		
S275J2G4	1.0145	Fe 430 D2	..					14 14-01					
S355JR	1.0045	Fe 510 B	..	E 36-2	AE 355 B	50 B	AE 355-B		Fe 510-B	St 510 C	NS 12 153		
S355J0	1.0553	Fe 510 C	St 52-3 U	E 36-3	AE 355 C	50 C	AE 355-C		Fe 510-C	St 510 D	NS 12 153		
S355J2G3	1.0570	Fe 510 D1	St 52-3 N		AE 355 D	50 D	AE 355-D		Fe 510-D				
S355J2G4	1.0577	Fe 510 D2	..						Fe 510-DD				
S355K2G3	1.0595	Fe 510 DD1	..	E 36-4	50 DD		AE 355-DD						
S355K2G4	1.0596	Fe 510 DD2	..										
E295	1.0050	Fe 490-2	St 50-2	A 50-2	A 490		A 490-2	15 50-00	Fe 490-2	St 490			
E335	1.0060	Fe 590-2	St 60-2	A 60-2	A 590		A 590-2	15 50-01	Fe 590-2	St 590			
E360	1.0070	Fe 690-2	St 70-2	A 70-2	A 690		A 690-2	16 50 00	Fe 690-2	St 690			
								16 55 00					
								16 55-01					

