INTERNATIONAL STANDARD

ISO
683-10
Second edition
1987-04-01

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
ORGANISATION INTERNATIONALE DE NORMALISATION
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Heat-treatable steels, alloy steels and free-cutting steels —

Part 10:
Wrought nitriding steels

Aciers pour traitement thermique, aciers alliés et aciers pour décolletage —

Partie 10: Aciers corroyés pour nitruration

Reference number
ISO 683-10: 1987 (E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 683-10 was prepared by Technical Committee ISO/TC 17, *Steel.*

This second edition cancels and replaces the first edition (ISO 683-10 : 1975), of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Printed in Switzerland

Heat-treatable steels, alloy steels and free-cutting steels —

Part 10: Wrought nitriding steels

1 Scope and field of application

1.1 This part of ISO 683 gives the technical delivery requirements for

— semi-finished products, for example blooms, billets, slabs (see note 3);

— bars (see note 3);

— wire rod;

— hot-rolled plates (see note 2);

— hammer or drop forgings (see note 3).

manufactured from the nitriding steels listed in table 3 and supplied in one of the heat-treatment conditions given for the different types of products in table 1, line 2 to 5 and in one of the surface conditions given in table 2.

The steels are in general intended for the fabrication of quenched and tempered and subsequently nitrided machine parts.

The requirements for mechanical properties given in this part of ISO 683 are restricted to the sizes given in table 6.

NOTES

1 Related International Standards are given in annex C.

2 The term "plate" includes in the following, unless otherwise stated, also wide flats.

3 Hammer-forged semi-finished products (blooms, billets, slabs etc.) and hammer-forged bars are in the following covered under semi-finished products or bars and not under the term "hammer and drop forgings".

1.2 In special cases variations in these technical delivery requirements or additions to them may form the subject of an agreement at the time of enquiry and order (see annex B).

1.3 In addition to this part of ISO 683 the general technical delivery requirements of ISO 404 are applicable.

2 References

ISO 83, *Steel — Charpy impact test (U-notch).*

ISO 148, *Steel — Charpy impact test (V-notch).*

ISO 377, *Wrought steel — Selection and preparation of samples and test pieces.*

ISO 404, *Steel and steel products — General technical delivery requirements.*

ISO/R 1024, *Rockwell superficial hardness test (N and T scales) for steel.*

ISO 1035, *Hot-rolled steel bars*

— *Part 1: Dimensions of round bars.*

— *Part 2: Dimensions of square bars.*

— *Part 3: Dimensions of flat bars.*

— *Part 4: Tolerances.*

ISO 3887, *Steel, non-alloy and low-alloy — Determination of depth of decarburization.*

ISO 6506, *Metallic materials — Hardness test — Brinell test.*

ISO 6507/1, *Metallic materials — Hardness test — Vickers test — Part 1:* HV 5 *to* HV 100.

ISO 6892, *Metallic materials — Tensile testing.*

ISO 6929, *Definition of steel products by shape and dimensions.* [1)]

ISO 7452, *Hot-rolled structural steel plates — Tolerances on dimensions and shape.*

ISO 7788, *Steel — Surface finish of hot-rolled plates and wide flats — Delivery conditions.*

3 Definitions

For deviations from normal definitions, see notes 2 and 3 to 1.1.

1) At present at the stage of draft.

For the purpose of this part of ISO 683, the definitions of ISO 6929, and the following, apply.

3.1 ruling section: That section for which the specified mechanical properties apply.

Independent of the actual shape and dimensions of the cross-section of the product the size of its ruling section is always given by a diameter. This corresponds to the diameter of an " equivalent round bar". That is, a round bar which, at the position of its cross-section specified for taking the test pieces for the mechanical tests, will, when being cooled from austenitizing temperature, show the same cooling rate as the actual ruling section of the product concerned at its position for taking the test pieces.

3.2 nitriding steels: Heat-treatable steels containing controlled amounts of the nitride forming elements, aluminium, chromium, molybdenum, and/or vanadium and are particularly suited for nitriding.

3.3 nitriding: A heat treatment characterized by keeping a steel product for a sufficiently long time at temperatures below the transformation temperature AC 1 in a nitrogen providing gaseous or liquid salt environment to achieve diffusion of the nitrogen into the steel surface.

An increase in surface hardness, wear resistance and fatigue properties is attained with this treatment.

4 Ordering and designation

The designation of the product in an order shall cover the following:

a) the designation of the product form (bloom, bar, wire rod, etc.) followed by

— either the designation of the dimensional standard and the dimensions and tolerances selected from this (see 5.7).

— or, for example in the case of drop forgings, by the designation of the drawing or any other document covering the dimensions and tolerances required for the product;

b) if another surface condition than "hot worked" or a special surface quality is required

— the surface condition (see table 2),

— the surface quality (see 5.6);

c) a description of the steel comprising

1) a reference to this part of ISO 683,

2) the designation of the steel type given in table 3,

3) if another heat-treatment condition than the untreated condition is required, the symbol for this other condition (see table 1, column 3),

4) if a document is required, the symbol for the required type of document (see table 8),

5) if any supplementary requirement shall be complied with, the symbol and, where necessary, the details of this supplementary requirement (see annex B).

Example:

To be ordered are:

Hot-rolled round bars,

according to ISO 1035/1,
with a nominal diameter of 40,0 mm,
a nominal length of 8 000 mm,
with a diameter tolerance of ± 0,40 mm (= class S according to ISO 1035/4),
a length tolerance of 0 + 100 mm (= class L2 according to ISO 1035/4),
all other tolerances as given in ISO 1035/4 for normal cases.

Surface

Blast cleaned (symbol BC, see table 2).

Steel

according to this part of ISO 683
type 31 CrMo 12 (see table 3)
heat-treatment condition: quenched + tempered (symbol Q + T, see table 1)
with an inspection certificate of type IC, (see table 8) and ultrasonically tested (supplementary requirement specified in annex B, clause B.2)
in accordance with test sheet *xy*.

Designation

Rounds: ISO 1035/1 – 40,0 S × 8 000 L2
Surface: BC
Steel: ISO 683/10 – 31 CrMo 12 – Q + T – IC – S2
Details: for ultrasonic test, see test sheet *xy*.

5 Requirements

5.1 Manufacturing process

5.1.1 General

The manufacturing process of steel and of the products is with the restriction given by the requirements in 5.1.2 to 5.1.3, left to the discretion of the manufacturer.

5.1.2 Heat-treatment and surface condition at delivery

5.1.2.1 Normal condition at delivery

Unless otherwise agreed at the time of enquiry and order, the products shall be delivered in the untreated, that means as hot-worked condition.

5.1.2.2 Particular heat-treatment condition

If so agreed at the time of enquiry and order, the products shall be delivered in one of the heat-treatment conditions given in table 1, line 3 to 5.

5.1.2.3 Particular surface conditions

If so agreed at the time of enquiry and order, the products shall be delivered in one of the particular surface conditions given in table 2, line 3 to 6.

5.1.3 Cast separation

The steels shall be delivered separated by casts.

5.2 Chemical composition, hardness and mechanical properties

The requirements for chemical composition, hardness and mechanical properties cited in table 1, column 9, apply as appropriate for the particular heat-treatment condition.

5.3 Technological properties

5.3.1 Machinability

All steels are in the condition "annealed to maximum hardness requirements" machinable.

Where a further improved machinability is required special heat treatments may be agreed at the time of enquiry and order.

5.3.2 Shearability

Under suitable shearing conditions (avoiding local stress peaks, preheating, application of blades with a profile adapted to that of the product etc.) all steels are shearable in the condition "annealed to maximum hardness requirements".

5.4 Structure

For the ferrite content in the core see annex B, clause B.5.

5.5 Internal soundness

The steel shall be free from internal defects likely to have an adverse effect (see annex B, clause B.2).

5.6 Surface quality and decarburization

5.6.1 All products shall have a workmanlike finish.

5.6.2 Minor surface discontinuities, which may occur also under normal manufacturing conditions, such as scores originating in the case of black steel from rolled-in scale, are not to be regarded as defects.

5.6.3 As long as no International Standard on the surface quality of steel products exists, detailed requirements referring to this characteristic shall, where appropriate, be agreed at the time of enquiry and order.

NOTES

1 For bars and wire rod included in this part of ISO 683, a separate International Standard on surface quality is in consideration.

2 It is more difficult to detect and eliminate surface discontinuities from coiled products than from cut lengths. This should be taken into account when agreements on surface quality are made.

3 For hot-rolled plates, the requirements for surface finish are, specified in ISO 7788.

4 Agreements for the admissible surface decarburization should, where appropriate, be based on one of the testing methods given in ISO 3887.

5.6.4 Removal of surface discontinuities by welding is not permitted.

Pending publication of a separate International Standard, the kind and permissible depth for removal of surface discontinuities should, where appropriate, be agreed at the time of enquiry and order.

5.7 Shape, dimensions and tolerances

The shape, dimensions and tolerances of the products shall comply with the requirements agreed at the time of enquiry and order. The agreements shall, as far as possible, be based on corresponding International Standards, otherwise on suitable national standards.

NOTE — The following International Standards cover dimensions and/or tolerances for products included in this part of ISO 683:

- for bars: ISO 1035/1 to 4
- for plates (except for wide flats): ISO 7452.

6 Inspection, testing and conforming of products

6.1 Inspection and testing procedures and types of documents

6.1.1 Table 8 gives a survey of the inspection procedures and the type of documents of ISO 404 which may be agreed at the time of enquiry and order for deliveries according to this part of ISO 683.

6.1.2 If in accordance with the agreements at the time of enquiry and order a test report (TR) is to be provided, this shall cover

a) the statement that the material complies with the requirements of the order;

b) the results of the cast analysis for all elements specified for the steel type supplied.

6.1.3 If in accordance with the agreements in the order an inspection certificate (IC or ICP) or an inspection report (IR) (see table 8) is to be provided, the specific inspections and tests described in 6.2 shall be carried out and their results shall be certified in the document.

In addition the document shall cover

a) for all elements specified for the steel type concerned the results of the cast analysis given by the manufacturer;

b) the result of all inspections and tests ordered by supplementary requirements (see annex B);

c) the symbol letters or numbers relating the test certificates, the test pieces and products to each other.

6.2 Specific inspection and testing

6.2.1 Verification of the hardness and mechanical properties

6.2.1.1 The hardness requirements or mechanical properties given for the relevant heat-treatment condition in table 1 column 9, sub-clause 2, shall, with the following exception, be verified. The requirement given in table 1, footnote 1 (mechanical properties of reference test pieces), is only to be verified if the supplementary requirement specified in annex B, clause B.1 is ordered.

6.2.1.2 The amount of testing, the sampling conditions and the test methods to be applied for the verification of the requirements shall be in accordance with the prescriptions of table 9.

6.2.2 Visual and dimensional inspection

A sufficient number of products are to be inspected to ensure the compliance with the specification.

6.2.3 Retests

6.2.3.1 Where for one or more test units one or more tests give unsatisfactory results the manufacturer has the choice of withdrawing the test units concerned (for example for retreatment or sorting in accordance with ISO 404) or of retaining them. If they are retained, retests are to be carried out according to the following rules.

6.2.3.2 If — as in the case of tensile tests or product analysis (see annex B, clause B.3) — only one test of the type concerned was carried out on the sample concerned and gave the unsatisfactory result, two new tests of the same type shall be carried out.

6.2.3.3 If one or more of the three individual impact tests to be carried out on test pieces from one sample was lower than 70 % of the specified mean value or if the mean value of these three impact tests was too low, two new series each consisting of the three impact tests shall be carried out.

6.2.3.4 If the test unit consists of more than one product and if the product from which the unsatisfactory test result stems is not withdrawn from the test unit one of the two new tests or test series shall be made on test pieces taken from the originally tested sample or product.

6.2.3.5 All retests shall give satisfactory results. Otherwise the test unit concerned is to be rejected.

7 Marking

The manufacturer shall mark the products or the bundles or boxes containing the products in a suitable way, so that the identification of the cast, the steel type and the origin of the delivery is possible (see annex B, clause B.4).

Table 1 — Combinations of usual heat-treatment conditions at delivery, product forms and requirements according to tables 3 to 6

1	2	3	4	5	6	7	8	9		10
1	**Heat-treatment condition at delivery**	**Symbol**	X = indicates applicable for					**Requirements**		**Remarks**
			Semi-products	Bars	Wire rod	Plates	Hammer and drop *forging*	1.	2.	
2	Untreated	none or U	X	X	X	X	X	Chemical composition according to tables 3 and 4	—[1] Maximum Brinell hardness according to table 5[1] Mechanical properties accoding to table 6	Observe also the supplementary requirements given in annex C
3	Annealed to *maximum hardness* requirements	A	X	X	X	X	X			
4	Quenched and tempered	Q + T	—	X	—	X	X			
5	Others	Other treatment conditions, for example special heat treatments for improving the machinability may be agreed at the time of enquiry and order.								

1) For deliveries in the condition "untreated" or "annealed to maximum hardness requirements", the values given in table 6 for the quenched and tempered condition shall be achievable after *appropriate heat treatment if so agreed at the time of enquiry and order (see clause B.1 in annex B).*

Table 2 — Surface condition at delivery

1	2	3	4	5	6	7	8	9	10
1	**Surface condition at delivery**			X indicates in general applicable for					
			Symbol	Semi-finished products	Bars	Wire rod	Plates	Hammer and drop forgings	**Notes**
2	Unless otherwise agreed	As hot worked	None or HW	X[1]	X	X	X	X	
3	Particular conditions supplied by agreement	HW + pickled	PI	X	X	X	X	X	—[3]
4		HW + blast cleaned	BC	X	X	X	X	X	
5		HW + rough machined	—[2]	—	X	X	—	X	
6		Others							

1) The term "hot worked" includes in the case of the semi-finished products also the continuously cast condition.

2) Until the term "rough machined" is defined by, for example, machining allowances, the details shall be agreed at the time of enquiry and order.

3) In addition it may be agreed that the products are oiled or, where appropriate, limed or phosphated.

Table 3 — Types of steel and specified chemical composition (applicable to cast analysis)[1]

Type of steel[2]	Chemical composition [% (*m*/*m*)]								
	C	Si max.	Mn	P max.	S max.[3]	Al	Cr	Mo	Ni max.
31 CrMo 12	0,28 to 0,35	0,40	0,40 to 0,70	0,030	0,035	—	2,80 to 3,30	0,30 to 0,50	0,30
33 CrAlMo 5 4	0,30 to 0,37	0,50	0,50 to 0,80	0,030	0,035	0,80 to 1,20	1,00 to 1,30	0,15 to 0,25	—
41 CrAlMo 7 4	0,38 to 0,45	0,50	0,50 to 0,80	0,030	0,035	0,80 to 1,20	1,50 to 1,80	0,25 to 0,40	—

1) Elements not quoted should not be intentionally added to the steel without the agreement of the purchaser, other than for the purpose of finishing the heat. All reasonable precautions should be taken to prevent the addition, from scrap or other materials used in manufacture, of such elements which affect the mechanical properties and applicability.

2) The designations are in accordance with the system proposed by ISO/TC 17/SC 2.

3) By agreement between the purchaser and manufacturer, the steel may be ordered with an upper limit of sulfur less than 0,035 % (*m*/*m*).

Table 4 — Permissible deviations between specified analysis and product analysis

Type of steel	Permissible deviation[1] [% (*m*/*m*)]								
	C	Si	Mn	P	S	Al	Cr	Mo	Ni
31 CrMo 12	± 0,01	+ 0,03	± 0,04	+ 0,005	+ 0,005	—	± 0,10	± 0,03	+ 0,03
33 CrAlMo 5 4	± 0,02	+ 0,03	± 0,04	+ 0,005	+ 0,005	± 0,10	± 0,05	± 0,03	—
41 CrAlMo 7 4	± 0,02	+ 0,03	± 0,04	+ 0,005	+ 0,005	± 0,10	± 0,05	± 0,03	—

1) ± means that in one cast the deviation may occur over the upper value or under the lower value of the specified range in table 3 but not both at the same time.

Table 5 — Hardness in the "annealed to maximum hardness requirements" condition

Type of steel	Hardness (HB[1] max.)
31 CrMo 12	248
33 CrAlMo 5 4	248
41 CrAlMo 7 4	262

1) HB is Brinell hardness (see ISO 6506).

Table 6 — Mechanical properties in the quenched and tempered condition[1]

Type of steel	Diameter	R_e min.	R_m	A min.	KU min.	KV[2] min.	Hardness of nitrided surface approximately[3]	
	mm	N/mm²[4]	N/mm²	%	J	J	HV	HR 15N
31 CrMo 12	≤ 100	800	1 000 to 1 200	11	30		800	92
	> 100 ≤ 250	700	900 to 1 100	12	30		800	92
33 CrAlMo 5 4	≤ 70	600	800 to 1 000	14	25		950	93,5
41 CrAlMo 7 4	≤ 100	700	900 to 1 100	12	20		950	93,5
	> 100 ≤ 160	600	800 to 1 000	14	25		950	93,5

1) R_e: yield stress (0,2 % proof stress); R_m: tensile strength; A: percentage elongation after fracture ($L_o = 5{,}65\sqrt{S_o}$; S_o is the area of the cross-section of the test piece); KU: impact strength with U-notch (see ISO 83); KV: impact strength with V-notch (see ISO 148); HV: Vickers hardness number (see ISO 6507/1); HR 15N: Rockwell superficial (N scale) hardness with 15 kgf load (see ISO/R 1024).

2) If testing of ISO-V-notch impact test pieces is required, the minimum impact strength value shall be agreed.

3) For information only.

4) 1 N/mm² = 1 MPa

Table 7 — Conditions for heat treatment (for guidance only)

Type of steel	Quenching[1]	Quenching agent	Tempering[2]	Nitriding[3]
31 CrMo 12	870 to 910	Oil	570 to 650	490 to 510
33 CrAlMo 5 4	900 to 940	Oil or water	570 to 650	500 to 520
41 CrAlMo 7 4	880 to 920	Oil	570 to 650	500 to 520

1) Time for austenitizing as a guide: 0,5 h minimum.

2) Time for tempering as a guide: 1 h minimun.

3) Time for nitriding depends on the desired depth of the nitrided case.

Table 8 — Applicable inspection procedures and types of documents

1 Symbol	2 Inspection and testing procedure	3 Type of document designation
—	Non-specific testing and inspection[1]	None
SC		Statement of compliance
TR		Test report
IC	Specific testing and inspection[2] by the qualified department of the manufacturer's works	Inspection certificate signed by the representative of the qualified department of the manufacturer's works
ICP	Specific testing and inspection[2] in the presence of the purchaser or a body designated by him	Inspection certificate signed by the purchaser or a body designated by him
IR		Inspection report signed by the manufacturer and purchaser or his representative

1) Non-specific inspection and testing is inspection and testing carried out by the manufacturer in accordance with his own procedures, on products made by the same manufacturing process, but not necessarily on the products actually supplied.

2) Specific inspection and testing means the inspection and testing procedure carried out on the products to be supplied, in order to verify whether these products comply with the requirements of the order.

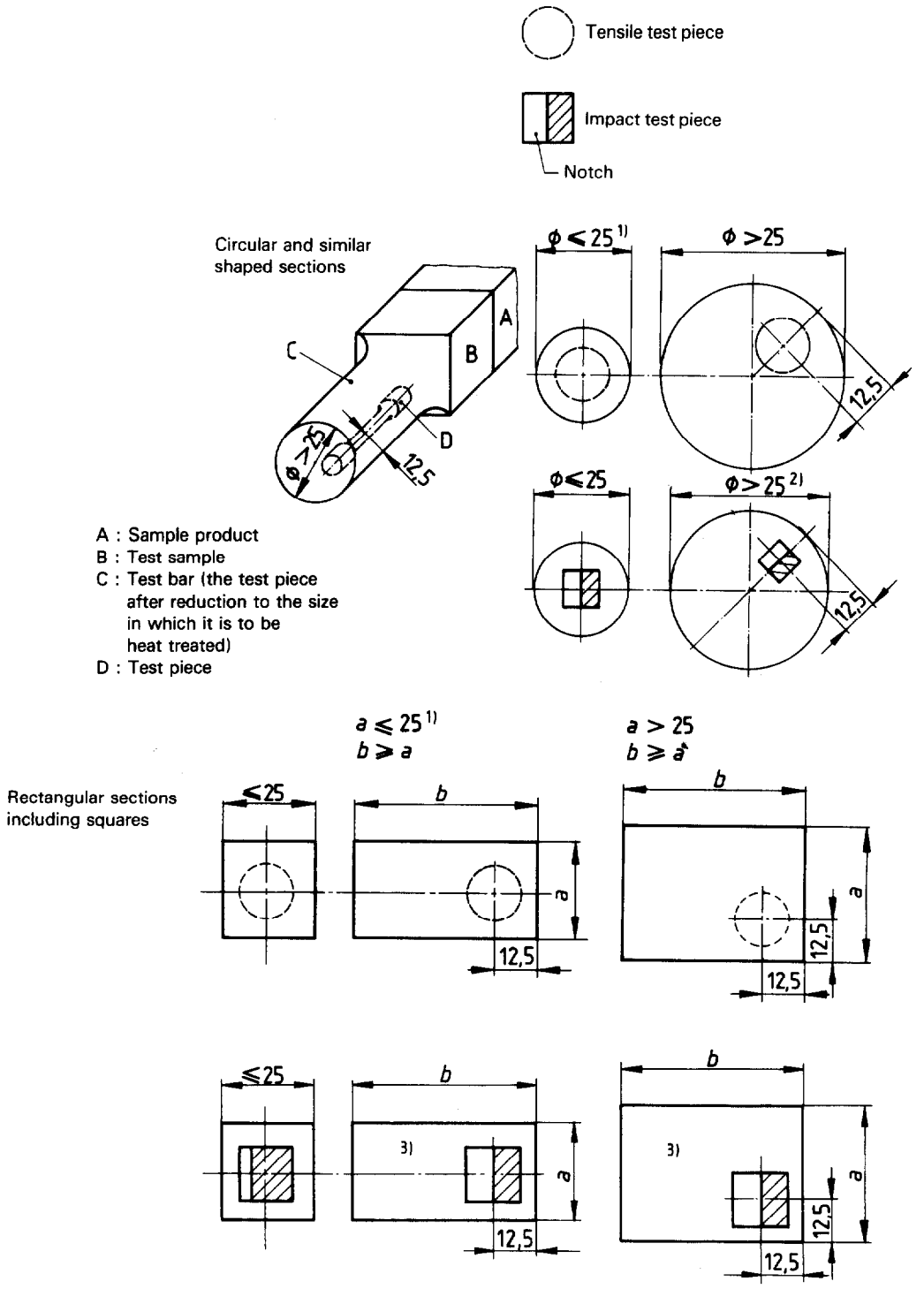
Table 9 — Test conditions for the verification of the requirements given in column 2

NOTE — Verification of the requirements is only necessary if an inspection certificate or an inspection report is ordered and if the requirement is applicable according to table 1, column 9.

1	2		3	4	5	6	7	Line	6a	7a
No.	**Requirements**		**Test unit**[1]	**Amount of testing**		**Sampling**	**Test method**		**Sampling**	**Test method**
		See table		**Number of sample products per test unit**	**Number of tests per sample product**	See in the supplement to this table, line T1 and line				
1	Chemical composition	3,4	C	(The cast analysis is given by the manufacturer; for product analysis, see clause B.3 in annex B)				T1	**General conditions** The general conditions for selection and preparation of test samples and test pieces for steel should be in accordance with ISO 377.	
2	Hardness in the condition A	5	C + D + T	1	1	T2		T2	**Hardness tests** In cases of dispute, the hardness shall be measured , if possible, at the circumference of the product in a distance of 1 × thickness from one end and in cases of products with square or rectangular cross-section in a distance of 0,25 × w, where w is the width of the product, from one longitudinal edge. If for example for hammer and drop forgings the above prescriptions prove unrealistic, a more appropriate postion of the hardness indentations shall be agreed at the time of enquiry and order.	According to ISO 6506
3	Mechanical properties of quenched and tempered products	6	C + D + T	1	1 tensile and 3 ISO U- or, if agreed, ISO V-notch impact tests	T3		T3	**Tensile and impact tests** The test pieces for tensile tests and, the test pieces for the ISO U- or ISO V-notch impact tests shall be taken — for bars and wire rod in accordance with figure 1 — for plates in accordance with figures 2 and 3. For hammer and drop forgings the test pieces shall be taken with their longitudinal axis parallel to the direction of principal grain flow from a position to be agreed at the time of enquiry and order.	The **tensile test** shall in cases of dispute be carried out in accordance with ISO 6892 on proportional test pieces having a gauge length of $L_o = 5{,}65\sqrt{S_o}$ where S_o is the area of the cross-section of the test piece. Where this is not possible — that means for flat products with thicknesses of about <3 mm, a test piece with constant gauge length in accordance with ISO 6892 shall be agreed at the time of enquiry and order. In this case also the minimum elongation value to be obtained for these test pieces shall be agreed. The **impact test**, where required, shall be made in accordance with ISO 83 or, if so agreed, ISO 148.

1) The tests are to be carried out separately for each cast as indicated by "C", each dimensions as indicated by "D" and each heat treatment batch as indicated by "T".
Products with different thickness may be grouped if the thicknesses lie in the same dimension range for mechanical properties and if the differences in thickness do not affect the properties. In cases of doubt the thinnest and the thickest product shall be tested.

Dimensions in millimetres



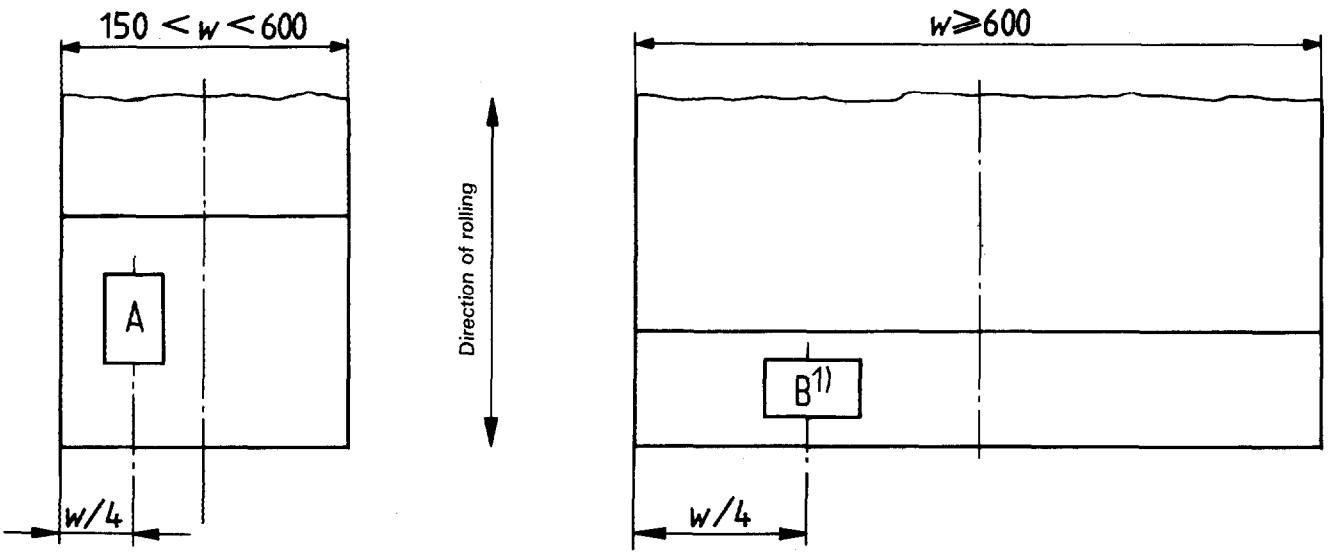
1) For small sized products (d or b < 25 mm), the test piece shall, if possible, consist of an unmachined part of the bar.

2) For round bars the direction of the notch axis shall be about parallel to the direction of the diameter running through the cross-section of the test piece.

3) For rectangular bars, the notch axis shall be perpendicular to the widest rolling surface.

Figure 1 — Location of the test pieces in bars and wire rods

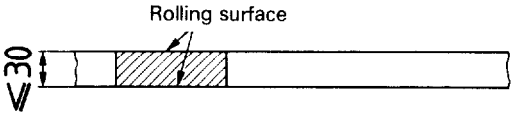
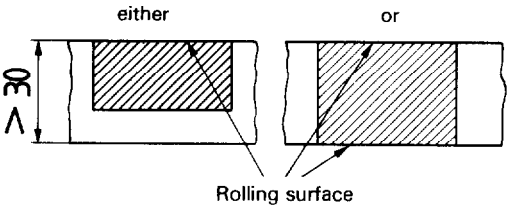
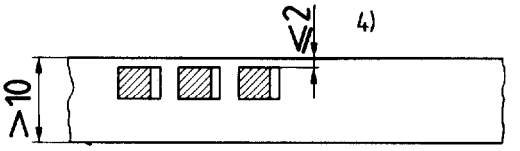
Dimensions in millimetres



1) In the case of steel types and conditions with specified impact properties, the width of the sample shall be sufficient for taking, in accordance with figure 3, longitudinal impact test pieces.

Figure 2 — Position of the test pieces within plates with reference to the width of the product

Figure 3 — Position to the test pieces in plates with reference to the thickness of the product and with reference to the direction of rolling

Type of test	Thickness of product	Orientation of test piece[1] for width, w		Distance of test piece from rolling surface
	mm	w < 600 mm	w ≥ 600 mm	mm
Tensile test[2]	≤ 30	longitudinal	transverse	
	> 30			
Impact test[3]	> 10[4]	longitudinal	longitudinal	

1) Orientation of the longitudinal axis of the test piece with reference to the main rolling direction.

2) The test piece shall be according to ISO 6892.

3) The notch axis shall be perpendicular to the product's surface.

4) For products of a thickness greater than 30 mm, the impact test piece may by agreement at the time of enquiry and order be sampled at a quarter of the thickness.

For products of a thickness between 5 and 10 mm, the width of the impact test piece is, generally, equal to the thickness of the product, the height remaining fixed at 10 mm. In case of dispute on V-notch impact test results from such subsize test pieces, subsize test pieces conforming with the dimensions given in ISO 148 (cross-section: 10 mm × 7,5 mm or 10 mm × 5 mm) shall be used.

Annex A

Ruling sections for the mechanical properties

(This annex forms an integral part of the Standard.)

A.1 Definition

See 3.1.

A.2 Determination of the diameter of the ruling section

A.2.1 If the test pieces are taken from products with simple cross-sections and from positions with quasi two-dimensional heat flow, A.2.1.1 to A.2.1.3 shall apply.

A.2.1.1 For round bars, the nominal diameter of the product (not comprising the machining allowances) shall be taken as diameter of the ruling section. .

A.2.1.2 For hexagons and octagons, the nominal distance between two opposite sides of the cross-section shall be taken as diameter of the ruling section.

A.2.1.3 For square and rectangular bars, the diameter of the ruling section shall be determined in the way shown in the example in figure 4.

A.2.2 For other product forms, the ruling section shall be agreed at the time of enquiry and order.

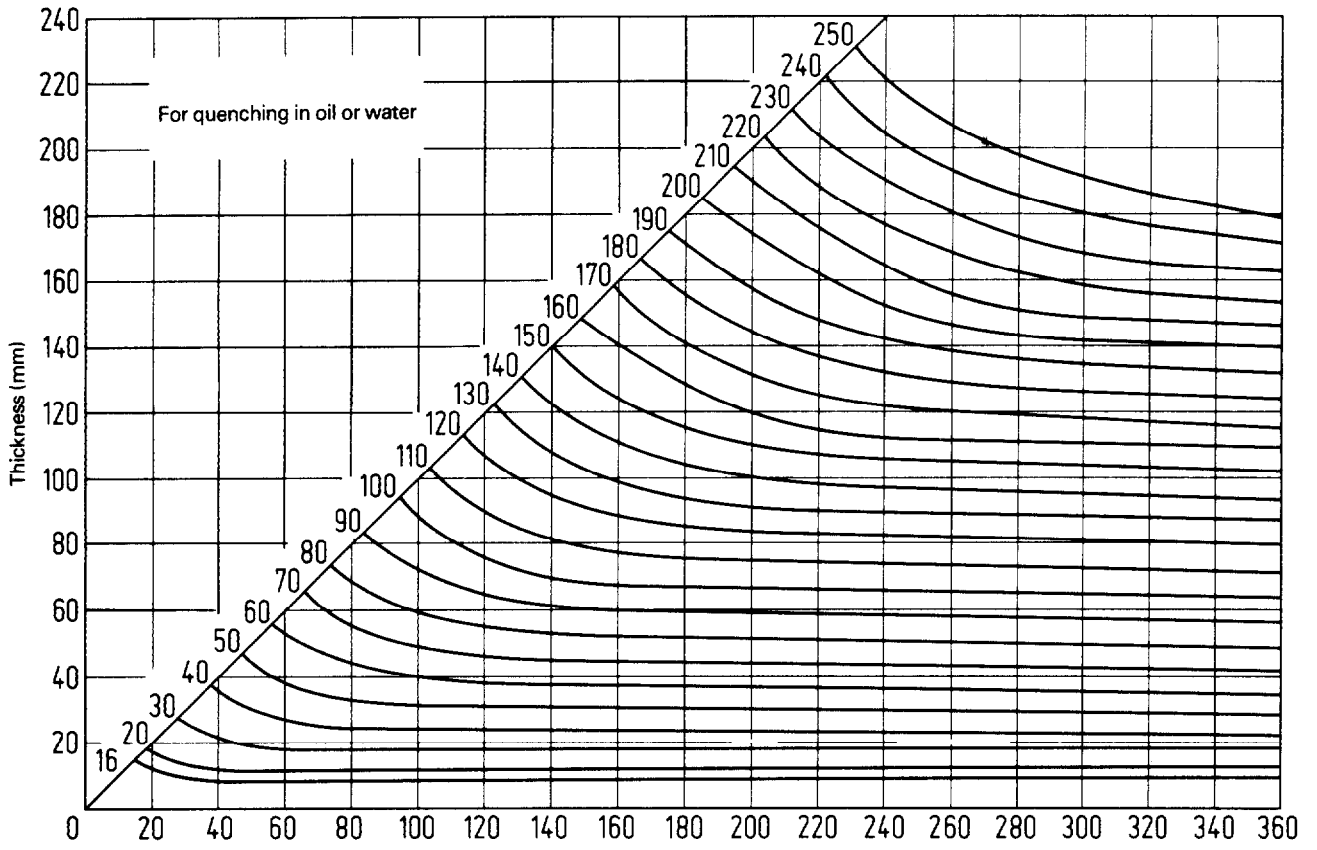


Figure 4 — Diameter of the ruling section of square and rectangular bars

Example: For a rectangular bar with a cross-section of 40 mm × 60 mm, the diameter of the ruling section is 50 mm.

Annex B

Supplementary or special requirements

(This annex forms an integral part of the Standard.)

NOTE — One or more of the following supplementary or special requirements shall be applied, but only when specified in the enquiry and order. Details of these requirements shall, where necessary, be agreed upon by the manufacturer and purchaser at the time of enquiry and order.

B.1 Mechanical properties of reference test pieces in the quenched and tempered condition

For deliveries in a condition other than quenched and tempered, the requirements for the mechanical properties in the quenched and tempered condition shall be verified on a reference test piece.

In the case of bars and wire rods the sample to be quenched and tempered sample shall, unless otherwise agreed, have the cross-section of the product. In all other cases the dimensions and the manufacture of the sample shall be agreed at the time of enquiry and order, where appropriate, while taking into consideration the indications for the determination of the ruling section given in annex A. The samples shall be quenched and tempered in accordance with the conditions given in the table for the heat-treatment conditions or as agreed at the time of enquiry and order. The details of the heat treatment shall be given in the document. The test pieces shall, unless otherwise agreed, be taken in accordance with the relevant specifications of the standard.

B.2 Ultrasonic tests

The products shall be ultrasonically tested under conditions and to an acceptance standard agreed at the time of enquiry and order.

B.3 Product analysis

One product analysis shall be carried out per cast for the determination of all elements for which values are specified for the cast analysis of the steel type concerned.

The conditions for sampling shall be in accordance with ISO 377. In cases of dispute, the analysis shall be carried out, if possible, according to the appropriate internationally standardized method.

B.4 Special agreements for marking

The products shall be marked in a way specially agreed at the time of enquiry and order.

B.5 Admissible ferrite content in the core of the product

The ferrite content in the core of the quenched and tempered product shall be determined on one microsection per cast, dimension and heat treatment batch.

The content shall not be higher than a value, α_{max}, agreed at the time of enquiry and order.

Annex C

List of related International Standards

(This annex does not form an integral part of the Standard.)

ISO 683/1, *Heat-treatable steels, alloy steels and free-cutting steels — Part 1: Direct hardening unalloyed and low alloyed wrought steel in form of different black products.*

ISO 683/11, *Heat-treated steels, alloy steels and free-cutting steels — Part 11: Wrought case hardening steels.*

UDC 669.14/.15.018.298.23

Descriptors : steels, heat treatable steels, alloy steels, nitriding steels, iron-and steel products, wrought products, specifications, acceptance testing, designation, marking.

Price based on 14 pages