
INTERNATIONAL STANDARD **ISO** 683 / XVIII



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

Heat-treated steels, alloy steels and free-cutting steels — Part 18 : Wrought unalloyed steels in the normalized, or normalized and cold-drawn, or hot-rolled and cold-drawn condition

Aciers pour traitement thermique, aciers alliés et aciers pour décolletage — Dix-huitième partie : Aciers corroyés non alliés normalisés, ou normalisés et étirés à froid, ou laminés à chaud et étirés à froid

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

International Standard ISO 683/XVIII was drawn up by Technical Committee ISO/TC 17, *Steel*, and circulated to the Member Bodies in November 1974.

It has been approved by the Member Bodies of the following countries:

Austria	India	South Africa, Rep. of
Belgium	Iran	Spain
Bulgaria	Ireland	Sweden
Canada	Italy	Switzerland
Czechoslovakia	Japan	Turkey
Denmark	Mexico	United Kingdom
Finland	Netherlands	U.S.S.R.
Germany	Poland	Yugoslavia
Hungary	Romania	

The Member Bodies of the following countries expressed disapproval of the document on technical grounds:

Australia
U.S.A.

Heat-treated steels, alloy steels and free-cutting steels — Part 18 : Wrought unalloyed steels in the normalized, or normalized and cold-drawn, or hot-rolled and cold-drawn condition

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard gives specifications for unalloyed wrought steels in

- a) the normalized condition, or
- b) the normalized and subsequently cold-drawn condition, or
- c) the hot-rolled and subsequently cold-drawn condition,

which are usually intended for mechanical purposes, for example for machine parts.

1.2 This International Standard comprises the four series of steels listed in table 2, which differ in their phosphorus and sulphur contents. The series designated with suffixes "a" or "b" have improved machinability.

2 REFERENCES

ISO 82, *Steel — Tensile testing.*

ISO 89, *Steel — Tensile testing of wire.*

ISO/R 377, *Selection and preparation of samples and test pieces for wrought steel.*

ISO/R 404, *General technical delivery requirements for steel.*

3 REQUIREMENTS

3.1 Production processes

Unless otherwise agreed in the order, the processes used in making the steel and the product are left to the discretion of the manufacturer, but the steel shall be killed. When he so requests, the user shall be informed what steelmaking process is being used.

3.2 Chemical composition and mechanical properties

3.2.1 The steels covered by this International Standard shall be ordered and delivered in accordance with table 1.

The type of condition of delivery, according to table 1, shall be stated at the time of enquiry and order.

TABLE 1 — Types of condition of delivery

Requirements	Types of condition of delivery ¹⁾		
	1	5(n)	6(n)
Chemical composition	X	X	X
Mechanical properties for final dimensions			
— in the normalized condition		X	
— in the normalized + cold-drawn, or hot-rolled + cold-drawn condition			X

1) The numbers and letters indicating the type of condition of delivery follow a co-ordinated series throughout all relevant ISO publications.

3.2.2 The chemical composition expressed by the cast analysis shall be in accordance with table 2.

3.2.2.1 If ordered to condition of delivery type 1 (see table 1), the values given in table 3 for the permissible deviations between the values specified in table 2 and the product analysis of products up to 160 mm diameter apply. Above 160 mm diameter, the permissible deviations shall be agreed at the time of enquiry and order.

3.2.2.2 If ordered to condition of delivery types 5(n) or 6(n), the mechanical properties specified in table 4 or table 5 shall be the governing criteria for acceptance. In such cases, the cast analysis may deviate slightly from the values shown in table 2.

3.2.3 If ordered to condition of delivery type 5(n) the mechanical properties shall be those shown in table 4; if ordered to condition of delivery type 6(n) they shall be those given in table 5.

3.2.3.1 The values apply to test pieces taken in the direction of the metal fibre, the axis of the test piece corresponding to that shown in the figure.

3.3 Tolerances on dimensions and mass

The tolerances allowable on dimensions and mass shall be stated on the order as in accordance with the appropriate International Standard. However, in cases where one does not exist the tolerances shall be stated on the order.

4 TESTING

4.1 Number of sample products

4.1.1 Chemical composition

The cast analysis shall be given by the manufacturer. If a product analysis is required by the purchaser, at least one sample product shall be taken from each cast.

4.1.2 Mechanical properties

4.1.2.1 For material supplied in the normalized condition (type of condition of delivery 5(n) of table 1), one sample product shall be taken from each size grouping from each normalized batch from each cast for testing in accordance with table 4.

4.1.2.2 If the product is continuously normalized, one sample product for each 25 t or part thereof, but at least one sample product for each cast, shall be taken.

4.1.2.3 For material supplied in either the normalized and subsequently cold-drawn condition or in the as-rolled and subsequently cold-drawn condition (type of condition of delivery 6(n) of table 1), one sample product shall be taken from each cold-drawn size from each normalized batch from each cast for testing in accordance with table 5.

4.2 Samples and test pieces

4.2.1 The test pieces for tensile test shall be taken in the longitudinal direction of the products in accordance with the figure.

4.2.2 For product analyses, the selection of test samples shall be carried out in accordance with the requirements of ISO/R 377.

4.2.3 General conditions for selection and preparation of test samples and test pieces for steel shall be in accordance with ISO/R 377.

4.3 Test methods

4.3.1 The tensile test shall be carried out in accordance with ISO 82 or ISO 89.

4.3.2 In cases of dispute, the methods for the chemical analyses shall be those established by the relevant International Standards. If no International Standards are available, the methods may be agreed upon and specified at the time of enquiry and order.

4.4 Retests

For retests ISO/R 404 is valid.

4.5 Certification of the tests

For certification ISO/R 404 is valid, acceptable documents being as follows :

- statement of compliance with the order, or
- report based on quality control, or
- works certificate, or
- test certificate, or
- certificate of acceptance.

5 DEFECTS AND DIMENSIONAL TOLERANCES

The conditions given in ISO/R 404 are valid for

- surface defects,
- rectification,
- internal defects,
- dimensional tolerances and
- reclaiming.

TABLE 2 — Types of steel and specified chemical composition (applicable to cast analysis) 1)

Type of steel	C %	Si %	Mn %	P % max.	S %
C10e C10ea C10eb C10	0,07 to 0,13	0,15 to 0,40	0,30 to 0,60	0,035	max. 0,035 0,020 to 0,035 0,030 to 0,050
0,050				max. 0,050	
C15e C15ea C15eb C15	0,12 to 0,18	0,15 to 0,40	0,30 to 0,60	0,035	max. 0,035 0,020 to 0,035 0,030 to 0,050
0,050				max. 0,050	
C20e C20ea C20eb C20	0,17 to 0,23	0,15 to 0,40	0,30 to 0,60	0,035	max. 0,035 0,020 to 0,035 0,030 to 0,050
0,050				max. 0,050	
C25e C25ea C25eb C25	0,22 to 0,29	0,15 to 0,40	0,40 to 0,70	0,035	max. 0,035 0,020 to 0,035 0,030 to 0,050
0,050				max. 0,050	
C30e C30ea C30eb C30	0,27 to 0,34	0,15 to 0,40	0,50 to 0,80	0,035	max. 0,035 0,020 to 0,035 0,030 to 0,050
0,050				max. 0,050	
C35e C35ea C35eb C35	0,32 to 0,39	0,15 to 0,40	0,50 to 0,80	0,035	max. 0,035 0,020 to 0,035 0,030 to 0,050
0,050				max. 0,050	
C40e C40ea C40eb C40	0,37 to 0,44	0,15 to 0,40	0,50 to 0,80	0,035	max. 0,035 0,020 to 0,035 0,030 to 0,050
0,050				max. 0,050	
C45e C45ea C45eb C45	0,42 to 0,50	0,15 to 0,40	0,50 to 0,80	0,035	max. 0,035 0,020 to 0,035 0,030 to 0,050
0,050				max. 0,050	
C50e C50ea C50eb C50	0,47 to 0,55	0,15 to 0,40	0,60 to 0,90	0,035	max. 0,035 0,020 to 0,035 0,030 to 0,050
0,050				max. 0,050	
C55e C55ea C55eb C55	0,52 to 0,60	0,15 to 0,40	0,60 to 0,90	0,035	max. 0,035 0,020 to 0,035 0,030 to 0,050
0,050				max. 0,050	
C60e C60ea C60eb C60	0,57 to 0,65	0,15 to 0,40	0,60 to 0,90	0,035	max. 0,035 0,020 to 0,035 0,030 to 0,050
0,050				max. 0,050	

1) Elements not quoted in table 2 shall 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 shall be taken to prevent the addition, from scrap or other materials used in manufacture, of such elements which affect the hardenability, mechanical properties and applicability.

TABLE 3 – Permissible deviations between specified analysis and product analysis

Type of steel	Permissible deviations ¹⁾				
	C %	Si %	Mn %	P %	S %
C10e, C10ea, C10eb, C10 C15e, C15ea, C15eb, C15 C20e, C20ea, C20eb, C20 C25e, C25ea, C25eb, C25 C30e, C30ea, C30eb, C30	± 0,02				
C35e, C35ea, C35eb, C35 C40e, C40ea, C40eb, C40 C45e, C45ea, C45eb, C45 C50e, C50ea, C50eb, C50 C55e, C55ea, C55eb, C55 C60e, C60ea, C60eb, C60					
	± 0,03	± 0,03	± 0,04	+ 0,005	+ 0,005
	± 0,04				

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 2 but not both at the same time.

TABLE 4 – Mechanical properties ¹⁾ for normalized condition

Type of steel	$\phi \leq 16$ mm			$16 \text{ mm} < \phi \leq 100$ mm			$100 \text{ mm} < \phi \leq 250$ mm		
	$R_{p0,2}$ min. N/mm ²	R_m min. N/mm ²	A min. %	$R_{p0,2}$ min. N/mm ²	R_m min. N/mm ²	A min. %	$R_{p0,2}$ min. N/mm ²	R_m min. N/mm ²	A min. %
C20e, C20ea, C20eb, C20	240	430	24	210	400	25	—	—	—
C25e, C25ea, C25eb, C25	260	470	22	230	440	23	—	—	—
C30e, C30ea, C30eb, C30	280	510	20	250	480	21	230	460	21
C35e, C35ea, C35eb, C35	300	550	18	270	520	19	245	500	19
C40e, C40ea, C40eb, C40	320	580	16	290	550	17	260	530	17
C45e, C45ea, C45eb, C45	340	620	14	305	580	16	275	560	16
C50e, C50ea, C50eb, C50	355	650	12	320	610	14	290	590	14
C55e, C55ea, C55eb, C55	370	680	11	330	640	12	300	620	12
C60e, C60ea, C60eb, C60	380	710	10	340	670	11	310	650	11

1) $R_{p0,2}$ = 0,2 % proof stress (yield stress).

R_m = tensile strength.

A = percentage elongation after fracture ($L_o = 5 d_o$).

1 N/mm² = 1 MPa