

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 683 /V

HEAT-TREATED STEELS, ALLOY STEELS
AND FREE-CUTTING STEELS

PART 5
WROUGHT QUENCHED AND TEMPERED MANGANESE STEELS

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 683/V, *Heat-treated steels, alloy steels and free-cutting steels – Part V : Wrought quenched and tempered manganese steels*, was drawn up by Technical Committee ISO/TC 17, *Steel*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question led to the adoption of a Draft ISO Recommendation.

In December 1967, this Draft ISO Recommendation (No. 1360) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Australia	India	Spain
Austria	Israel	Sweden
Belgium	Italy	Switzerland
Canada	Japan	Thailand
Colombia	Korea, Rep. of	Turkey
Czechoslovakia	Netherlands	U.A.R.
Denmark	New Zealand	United Kingdom
Finland	Norway	U.S.A.
France	Poland	U.S.S.R.
Germany	Romania	
Hungary	South Africa, Rep. of	

One Member Body opposed the approval of the Draft :

Brazil

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in January 1970, to accept it as an ISO RECOMMENDATION.

HEAT-TREATED STEELS, ALLOY STEELS AND FREE-CUTTING STEELS

PART 5

WROUGHT QUENCHED AND TEMPERED MANGANESE STEELS

1. SCOPE

- 1.1 This ISO Recommendation covers wrought manganese steels for mechanical purposes, and usually intended for use
- (a) in the quenched and tempered condition, or
 - (b) in the austempered condition,
- with or without subsequent cold reduction.
- 1.2 For the purpose of simplification, the steels covered by this ISO Recommendation in both conditions are called "quenched and tempered steels" and both conditions are summarized under the term "quenched and tempered".
- 1.3 The types of steel 1 a, 1 b, 2 a and 2 b are listed with special requirements for the sulphur content in order to improve machinability.

2. REQUIREMENTS

2.1 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 should be killed. When he so requests, the user should be informed what steelmaking process is being used.

2.2 Chemical composition, mechanical properties and hardenability

- 2.2.1 The steels covered by this ISO Recommendation should be ordered and delivered in accordance with Table 1.

TABLE 1 – Types of condition of delivery

Requirements	Types of condition of delivery*									
	1	1(a)	2	2(a)	3	3(a)	4	4(a)	5	6
Chemical composition	X	X	X	X	X	X	X	X	X	X
Hardenability	—	—	X	X	—	—	—	—	—	—
Hardness in a condition of delivery other than quenched and tempered	—	X	—	X	—	X	—	X	—	—
Mechanical properties of										
— quenched and tempered test bars of 16 mm diameter	—	—	—	—	X	X	—	—	—	—
— quenched and tempered ruling sections	—	—	—	—	—	—	X	X	—	—
— quenched and tempered product in final dimensions	—	—	—	—	—	—	—	—	X	—
— quenched and tempered product subsequently cold-reduced to final dimensions	—	—	—	—	—	—	—	—	—	X

* The numbers indicating the type of condition of delivery follow a co-ordinated series of numbers throughout all relevant ISO Recommendations.

The type of condition of delivery according to Table 1 should be stated at the time of enquiry and order.

2.2.2 The chemical composition expressed by the cast analysis should be in accordance with Table 2.

TABLE 2 – Types of steel and chemical composition guaranteed
(applicable to cast analysis)*

Type of steel	C %	Si %	Mn %	P %** max.	S %**
1	0.25 to 0.32	0.15 to 0.40	1.30 to 1.65	0.035	0.035 max.
1 a					0.020 to 0.035
1 b					0.030 to 0.050
2	0.33 to 0.40	0.15 to 0.40	1.30 to 1.65	0.035	0.035 max.
2 a					0.020 to 0.035
2 b					0.030 to 0.050

* Elements not quoted in Table 2 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 hardenability, mechanical properties and applicability.

** If agreed between the purchaser and the manufacturer, the steel may be ordered with an upper limit of sulphur and phosphorus less than 0.035 %.

2.2.2.1 If ordered to conditions of delivery type 1 or 1(a) (see Table 1), the following permissible deviations between the values specified in Table 2 and the product analysis of products up to 160 mm (6.3 in) diameter should apply. Above 160 mm (6.3 in) diameter, the permissible deviations should be stated at the time of enquiry and order.

TABLE 3 – Permissible deviations between specified analysis and product analysis

Type of steel	Permissible deviations*				
	C %	Si %	Mn %	P %	S %
1	± 0.02	± 0.03	± 0.06	+ 0.005	+ 0.005
1 a					± 0.005
1 b					± 0.005
2					+ 0.005
2 a					± 0.005
2 b					± 0.005

* ± 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.

2.2.2.2 If ordered to condition of delivery types 2, 2(a), 3, 3(a), 4, 4(a), 5 and 6, the mechanical properties or hardenability specified in Tables 4, 5 and 7 should be the governing criteria for acceptance. In such cases, the cast analysis may deviate slightly from the values shown in Table 2.

2.2.3 If specified, the mechanical properties should be those shown in Table 4 or Table 5.

2.2.3.1 The values apply to test pieces, taken on rounds in the direction of the metal fibre, the axis of the test piece corresponding to that shown in Figure 1.

2.2.3.2 For rectangular sections, the ranges for equivalent diameters are given in Figure 2.

2.2.3.3 For other sections, the equivalent diameter should be agreed at the time of enquiry and order.

2.2.4 The mechanical properties in the quenched and tempered condition as given in Table 4 are those which can be obtained for one of the conditions given below :

- (1) For a reference test bar of 16 mm diameter, taken from the product to be delivered either by machining from a location according to Figure 1 or by forging, and then quenched and tempered according to the temperatures listed in Table 8 (types of condition of delivery 3 and 3(a) of Table 1).
- (2) For a ruling section*, to be specified at the time of enquiry and order, which is quenched and tempered according to the temperatures listed in Table 8 (types of condition of delivery 4 and 4(a) of Table 1).
For location of the test bar, see clause 3.2.1.
- (3) For the product in the quenched and tempered condition of delivery (type of condition of delivery 5 of Table 1).
For location of the test bar, see clause 3.2.1.

2.2.5 The mechanical properties in the quenched and tempered and subsequently cold-reduced condition as given in Table 5 may be agreed for the product to be delivered in this condition (type of condition of delivery 6 of Table 1).

For location of the test bar, see clause 3.2.1.

2.2.6 If the products are delivered in a condition other than quenched and tempered, with or without subsequent cold reduction, a maximum hardness in accordance with Table 6, measured after preparation of the surface in the conventional manner, may be agreed in addition to the other requirements (types of condition of delivery 1(a), 2(a), 3(a) and 4(a) of Table 1).

2.2.6.1 Mechanical properties for the normalized condition for the types of steel 1, 1 a and 1 b are given for information in Table 9.

2.2.7 When ordering on hardenability (types of condition of delivery 2 and 2(a) of Table 1), the Rockwell C hardness numbers given in Table 7 and the scatter bands in Figure 3 apply.

2.3 Tolerances on dimensions and mass

The tolerances allowable on dimensions and mass should be stated in the order, as long as there are no ISO Recommendations to cover them.

3. TESTING

3.1 Number of sample products

3.1.1 *Chemical composition.* The cast analysis is given by the manufacturer. If a product analysis is required by the purchaser, at least one sample product should be taken from each cast.

* In the selection of a steel, one of the most important considerations is whether the mechanical properties required can be obtained from the steel in the size and shape at the time of heat treatment. That portion, which is most important from the point of view of the mechanical properties obtained by heat treatment, is referred to as the ruling section, and the ruling section should always be expressed in terms of the diameter of an equivalent round bar (see Fig. 1).