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中华人民共和国国家标准

National standard of the People's Republic of China

GB/T 700—2006
代替 GB/T 700—1988

碳　素　结　构　钢

Carbon structural steels

(ISO 630:1995, Structural steels—
Plates, wide flats, bars, sections and profiles, NEQ)

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Foreword

This standard is not equivalent to ISO 630:1995 Structural Steels in the respect of consistency. The main differences between the two standards are as follows:

——No grades are specified corresponding to the yield strength levels of 185N/mm^2 and 355N/mm^2;

——Grades Q195 and Q215 are specified corresponding to levels 195N/mm^2 and 215N/mm^2;

——The phosphorus contents of class A steels of Q235 and Q275 are decreased by 0.005%;

——The thickness of Q235 class B steel is divided into two levels according to the deoxidization method and the carbon content is 0.20% in both levels;

——Q235 class B steel of which the thickness is smaller than 25mm may not be subject to test with the consent of the buyer if the supplier can ensure that the impact absorbed energy is up to standard;

——The yield strength of Q275 steel of which the thickness is bigger than 80mm-100mm is increased by 10N/mm^2;

——Cold bending test is added;

——Detailed batching rules are specified according to the situation of China.

This standard replaces GB/T 700-1988 Carbon Structural Steels and has the following changes in comparison with GB/T 700-1988:

——Semi-killed steel is cancelled in "deoxidization method";

——Grades Q255 and Q275 in GB/T 700-1988 are cancelled;

——Grade E275 in ISO 630:1995 is newly added and changed to the new grade Q275;

——The lower limits of carbon and manganese contents of each grade are cancelled, and the upper limit of manganese content is increased;

——The limit of silicon content of rimmed steel and killed steel is cancelled;

——Silicon content is changed from 0.30% to 0.35% (except for Q195);

——The phosphorus and sulphur contents of grade Q195 are decreased respectively from 0.045% and 0.050% to 0.035% and 0.040%;

——The regulation for the elongation after fracture of the thickness (or diameter) level of not bigger than 16mm is cancelled;

——"the upper limit of the tensile strength of wide strip steel (including sheared steel plate) is not used as a term of delivery" and "Q235 class B steel of which the thickness is smaller than 25mm may not be subject to test with the consent of the buyer if the supplier can ensure that the impact absorbed energy is up to standard" are added in the footnotes of Table 2;

——The regulation for the nitrogen content in the steel is modified;

——The regulation for impact test is modified and the figure of the minimum impact absorbed energy of the samples of which the thickness is 5mm-10mm is added;

——The basis of batching is changed from "the same furnace and kettle number" to "the same furnace number" and the limitation for the furnace number of mixed batch is cancelled.

Annex A of this standard is normative.

This standard was proposed by China Iron and Steel Association.

This standard is under the jurisdiction of National Technical Committee for Steel Standardization.

This standard was drafted by China Metallurgical Information & Standardization Institute, Capital Iron and Steel Company, Handan Iron & Steel Group and Benxi Iron & Steel Group Co., Ltd.

The main drafters of this standard are Tang Yifan, Luan Yan, Wang Liping, Sun Ping, Zhang Xianfeng and Dai Qiang.

This standard was first issued in January 1965, first revised in October 1979 and revised for the second time in June 1988.

Carbon structural steels

1 Scope

This standard specifies the grade, dimension, shape, weight and permissible deviation, technical requirements, test methods, inspection rules, packing, marking and quality certificate of carbon structural steel.

This standard is applicable to the structural hot rolled steel sheets, steel strips, sectional steels and bar steels generally used for welding, riveting and bolting engineering in delivery state.

The chemical composition specified by this standard is also applicable to steel ingots, continuous casting billets, steel billets and their products.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this standard. For dated references, subsequent amendments (not including corrections) to, or revisions of, any of these publications do not apply. However parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

GB/T 222-2006 Permissible tolerances for chemical composition of steel products

GB/T 223.3 Methods for chemical analysis of iron, steel and alloy--The diantipyryl methane phosphomolybdate gravimetric method for the determination of phosphorus content

GB/T 223.10 Methods for chemical analysis of iron, steel and alloy--The cupferron separation-chrome azurol S photometric method for the determination of aluminum content

GB/T 223.11 Methods for chemical analysis of iron, steel and alloy--The ammonium persulfate oxidation volumetric method for the determination of chromium content

GB/T 223.18 Methods for chemical analysis of iron, steel and alloy--The sodium thiosulfate separation iodimetric method for the determination of copper content

GB/T 223.19 Methods for chemical analysis of iron, steel and alloy--The neocuproine-chloroform extraction photometric method for the determination of copper content

GB/T 223.24 Methods for chemical analysis of iron, steel and alloy--The extraction separation-dimethylglyoxime spectrophotometric method for the determination of nickel content

GB/T 223.32 Methods for chemical analysis of iron, steel and alloy--The hypophosphite reduction-iodimetric method for the determination of arsenic content

GB/T 223.37 Methods for chemical analysis of iron, steel and alloy--The indophenol blue photometric method for the determination of nitrogen content after distillation separation

GB/T 223.58 Methods for chemical analysis of iron, steel and alloy--The sodium arsenite-sodium nitrite titrimetric method for the determination of manganese content

GB/T 223.59 Methods for chemical analysis of iron,steel and alloy--The reduced molybdoantimonyl phosphoric acid photometric method for the determination of phosphorus content

GB/T 223.60 Methods for chemical analysis of iron, steel and alloy--The perchloric acid

dehydration gravimetric method for the determination of silicon content

GB/T 223.63 Methods for chemical analysis of iron, steel and alloy--The sodium (potassium) periodate photometric method for the determination of manganese content

GB/T 223.64 Methods for chemical analysis of iron, steel and alloy--The flame atomic absorption spectrometric method for the determination of manganese content

GB/T 223.68 Methods for chemical analysis of iron, steel and alloy--The potassium iodate titration method after combustion in the pipe furnace for the determination of sulfur content

GB/T 223.71 Methods for chemical analysis of iron, steel and alloy--The gravimetric method after combustion in the pipe furnace for the determination of carbon content

GB/T 223.72 Methods for chemical analysis of iron, steel and alloy—The alumina chromatographic separation-barium sulfate gravimetric method for the determination of sulphur content

GB/T 228 Metallic materials - Tensile testing at ambient temperature (GB/T 228-2002, eqv ISO 6892:1998)

GB/T 229 Metallic materials - Charpy notch impact test (GB/T 229-1994, eqv ISO 83:1976, eqv ISO 148:1983)

GB/T 232 Metallic materials--Bend test (GB/T 232-1999, eqv ISO 7438:1985)

GB/T 247 General rule of acceptance, package, mark and certification for steel plates (sheets) and strips

GB/T 2101 General regulation of the checkout, package, mark and quality certificate of profiled bar

GB/T 2975 Steel and steel products – Location and preparation of test pieces for mechanical testing (GB/T 2975-1998, eqv ISO 377:1997)

GB/T 4336 Standard test method for spark discharge atomic emission spectrometric analysis of carbon and low-alloy steel (routine method)

GB/T 20066 Steel and iron--Sampling and preparation of samples for the determination of chemical composition (GB/T 20066-2006, ISO 14284:1996, IDT)

3 Denotation of the grade and symbols

3.1 Denotation of the grade

The grade of steel is composed of the letter representing yield strength, value of yield strength, symbol of quality grade and symbol of deoxidization method in turn. For example: Q235AF.

3.2 Symbols

Q——First letter of Chinese phonetic spelling for the "Qu" word of steel yield strength;

A, B, C, D——Are respectively quality grade;

F——First letter of Chinese phonetic spelling for the "Fei" word of rimmed steel;

Z——First letter of Chinese phonetic spelling for the "Zhen" word of killed steel;

TZ—— First letters of Chinese spelling for the "Tezhen" word of special killed steel.

In the denotation of grade components, symbols "Z" and "TZ" can be omitted.

4 Dimension, shape, weight and permissible deviation

The dimension, shape, weight and permissible deviation of steel sheets, steel strips, sectional steels and bar steels shall meet the specification of the corresponding standards respectively.

5 Technical requirements

5.1 Grade and chemical composition

5.1.1 The grade and chemical composition (smelting analysis) of the steel shall conform to Table 1.

Table 1

Grade	Unified Numerical Code[a]	Class	Thickness (or Diameter)/mm	Deoxidization Metod	Chemical Composition (Mass Percentage)/%, not higher than				
					C	Si	Mn	P	S
Q195	U11952	—	—	F,Z	0.12	0.30	0.50	0.035	0.040
Q215	U12152	A	—	F,Z	0.15	0.35	1.20	0.045	0.050
	U12155	B							0.045
Q235	U12352	A	—	F,Z	0.22	0.35	1.40	0.045	0.050
	U12355	B			0.20[b]				0.045
	U12358	C		Z	0.17			0.040	0.040
	U12359	D		TZ				0.035	0.035
Q275	U12752	A	—	F,Z	0.24	0.35	1.50	0.045	0.050
	U12755	B	≤40	Z	0.21			0.045	0.045
			>40						
	U12758	C	—	Z	0.22			0.040	0.040
	U12759	D		TZ	0.20			0.035	0.035

a The codes listed in the table are the unified numerical codes for killed and special killed steels. The unified numerical codes for rimmed steels are as follows:

Q195F-U11950;

Q215AF-U12150, Q215BF-U12153;

Q235AF-U12350, Q235BF-U12353;

1275AF-U12750.

b With the consent of the buyer, the carbon content of Q235B may not be higher than 0.22%.

5.1.1.1 Class D steels shall have the element with sufficiently refined grains, of which the content shall be indicated in the quality certificate. When aluminum deoxidization is used, the content of acid soluble alumnium in the steel shall not be lower than 0.015% or, alternatively, the total aluminum content shall not be lower than 0.020%.

5.1.1.2 The contents of residual elements chromium, nickel and copper in the steel shall not be higher than 0.30% respectively, the nitrogen content shall not be higher than 0.008%. The contents of these elements may not be subject to analysis if they can be guaranteed by the supplier.

5.1.1.2.1 The nitrogen content is allowed to exceed the value specified in 5.1.1.2. However, with every 0.001% increment of nitrogen content, the maximum phosphorus content shall decrease by 0.005%, the maximum nitrogen content obtained through smelting analysis shall not be higher than 0.012%. If the content of acid soluble aluminum in the steel is not lower than 0.015% or the

total aluminum content is not lower than 0.020%, the upper limit of nitrogen content may not be limited. The elements for nitrogen fixation shall be indicated in the quality certificate.

5.1.1.2.2 With the consent of the buyer, the copper content of class A steel may not be higher than 0.35%. In this case, the supplier shall analyze the copper content and indicate its content in the quality certificate.

5.1.1.3 The arsenic content in the steel shall not be higher than 0.080%. For the steels smelted with arsenic mineral smelting pig iron, the arsenic content shall be specified through negotiation between both parties. If the raw material does not contain arsenic, the analysis of arsenic may not be carried out.

5.1.1.4 If it can be ensured that the mechanical properties of the steel meet the specification of this standard, the carbon, manganese and silicon contents of the Class A steel of each grade may not be used as terms of delivery. However, their contents shall be indicated in the quality certificate.

5.1.1.5 In case commercial continuous casting billets, steel ingots and steel billets are supplied, the lower limits of carbon and manganese contents of each grade can be specified according to the requirements of the buyer in order to ensure that the performances of rolled steels meet the requirements of this standard.

5.1.2 The permissible deviation of the chemical composition of steel product, continuous casting billet and steel billet shall meet the specification of Table 1 of GB/T 222-2006.

The nitrogen content is permitted to exceed the specified value. However, it must meet the requirement of clause 5.1.1.2.1. The maximum nitrogen content obtained through product analysis shall not be higher than 0.014%. If the aluminum content in the steel reaches the value specified in **5.1.1.2.1** And is specified in the quality certificate, the upper limit of nitrogen content may not be limited.

The chemical composition deviation of the products and billets of rimmed steel is not guaranteed.

5.2 Smelting method

The steel is smelted in oxygen converter or electric furnace. The smelting method is generally selected by the supplier unless the buyer has special requirements and they are noted in the contract.

5.3 Delivery state

The steels are generally delivered in hot rolled, controlled rolled or normalized state.

5.4 Mechanical property

5.4.1 The results of tensile and impact tests of the steel shall meet the specification of Table 2. The result of bending test shall meet the specification of Table 3.

5.4.2 The thickness (diameter) of the steel products made of Q195 and Q235 class B rimmed steels shall not be bigger than 25mm.

5.4.3 When carrying out tensile and cold bending tests, longitudinal samples shall be taken for sectional steels and bar steels, transverse samples shall be taken for steel sheets and steel strips. The elongation after fracture is allowed to be 2% lower (absolute value) than the value specified in Table 2. If the transverse sampling of narrow steel strips is limited by the width, longitudinal samples can be taken.

5.4.4 Inspection may not be carried out if the supplier can ensure that the cold bending test meets the specification of Table 3. If Class A steel passes the cold bending test, the upper limit of

tensile strength may not be used as a term of delivery.

5.4.5 The steel products of which the thickness is not smaller than 12mm or the diameter is not smaller than 16mm shall be subject to impact test. The dimension of sample is 10mm×10mm×55mm. Through negotiation between both parties, the steels of which the thickness is 6mm~12mm or the diameter is 12mm-16mm can be subject to impact test. The dimension of sample is 10mm×7.5mm×55mm or 10mm×5mm×55mm or 10mm×product thickness×55mm. The specified impact absorbed energy is given in Annex A. For example, if the sample of 10mm×5mm×55mm is used, the test result shall not be smaller than 50% of the specified value.

5.4.6 The Charpy (V-notch) impact absorbed energy shall be obtained by calculating the arithmetic mean of the single values of three samples in one group. The single value of one sample is allowed to be less than the specified value. However, it shall not be less than 70% of the specified value.

If the above condition is not met, carry out the test on another three samples taken from the same product, the mean value of the six samples shall not be less than the specified value. The values of two samples are allowed to be less than the specified value. However, only one sample is allowed to be less than 70% of the specified value.

Table 2

Grade	Class	Yield Strength[a] R_{eH}/(N/mm²), not less than						Tensile Strength[b] R_m/(N/mm²)	Elongation after Fracture A/%, not less than					Impact Test (V-Notch)	
		Thickness (or Diameter)/mm							Thickness (or Diameter)/mm					Temperature/℃	Impact Absorbed Energy (Longitudinal)/J not less than
		≤16	>16~40	>40~60	>60~100	>100~150	>150~200		≤40	>40~60	>60~100	>100~150	>150~200		
Q195	—	195	185	—	—	—	—	315~430	33	—	—	—	—	—	—
Q215	A	215	205	195	185	175	165	335~450	31	30	29	27	26	—	—
	B													+20	27
Q235	A	235	225	215	215	195	185	370~500	26	25	24	22	21	—	—
	B													+20	27[c]
	C													0	
	D													-20	
Q275	A	275	265	255	245	225	215	410~540	22	21	20	18	17	—	—
	B													+20	27
	C													0	
	D													-20	

a The yield strength of Q195 is for reference only and not used as a term of delivery.

b For the steel products of which the thickness is bigger than 100mm, the lower limit of tensile strength is allowed to decrease by 20N/mm². The upper limit of the tensile strength of wide strip steel (including sheared steel plate) is not used as a term of delivery.

c Q235 class B steel of which the thickness is smaller than 25mm may not be subject to test with the consent of the buyer if the supplier can ensure that the impact absorbed energy is up to standard.

Table 3

Grade	Direction of Sample	Cold Bending Test 180° B=2a[a]	
		Thickness (or Diameter) of Steel Product[b]/mm	
		≤ 60	>60~100
		Bending Diameter d	
Q195	Longitudinal	0	—
	Transverse	0.5a	
Q215	Longitudinal	0.5a	1.5a
	Transverse	a	2a
Q235	Longitudinal	a	2a
	Transverse	1.5a	2.5a
Q275	Longitudinal	1.5a	2.5a
	Transverse	2a	3a

a B is the width of the sample, a is the thickness (diameter) of the sample.

b If the thickness (diameter) of the steel product is bigger than 100mm, the bending test shall be determined through negotiation between both parties.

5.5 Surface quality

The surface quality of steel products shall respectively meet the specifications of the relevant product standards for steel sheets, steel strips, sectional steels and bar steels.

6 Test methods

6.1 The inspection items, sampling number, sampling methods and test methods for each eatch of steel products shall meet the specifications of Table 4.

Table 4

No.	Inspection Item	Sampling Number/Piece	Sampling Method	Test Method
1	Chemical analysis	1 (per furnace)	GB/T 20066	GB/T 223 series standards and GB/T 4336 in Chapter 2
2	Tensile	1	GB/T 2975	GB/T 228
3	Cold bending			GB/T 232
4	Impact	3		GB/T 229

6.2 In tensile and cold bending tests, the longitudinal axis of the samples of steel sheets and steel strips shall be perpendicular to the rolling direction, while the longitudinal axis of the samples of sectional steels, bar steels and narrow steel strips limited by the width shall be parallel to the rolling direction.

6.3 The longitudinal axis of the impact sample shall be parallel to the rolling direction. The impact sample can reserve one rolled surface.

7 Inspection rules

7.1 The inspection and acceptance of the steel products shall be carried out by the technical supervision department of the supplier. The buyer has the right to carry out inspection and acceptance on any inspection item specified in this standard or the contract.

7.2 The steel products shall be accepted in batches, each batch comprised of the steel products of

the same grade, same furnace number, same quality grade, same variety, same dimension and same delivery state. The weight of each batch shall not be greater than 60t.

For the steel products rolled with the steels smelted in the steel-making furnaces of which the nominal capacity is small, the Class A or Class B steels of the same furnace number and same grade and manufactured by the same smelting, pouring and deoxidization methods are allowed to form a mixed batch. However, the carbon content difference between the various furnace numbers of each batch shall not be bigger than 0.02%, the manganese content difference shall not be bigger than 0.15%.

7.3 If the Charpy (V-notch) impact test result of the steel product does not meet the specification of 5.4.6, the sampling product shall be rejected. Take another two sampling products from the remaining part of this inspection batch and select a new group of three samples from each sampling product. The retest results of these two groups of samples shall be eligible. Otherwise, this batch of product shall not be delivered.

7.4 The retest and inspection rules of other inspection items of steel products shall meet the specifications of GB/T 247 and GB/T 2101.

8 Packing, marking and quality certificate

The packing, marking and quality certificate of the steel product shall meet the specifications of GB/T 247 and GB/T 2101.

Appendix A

(Normative)

Impact absorbed energy of small-sized impact sample

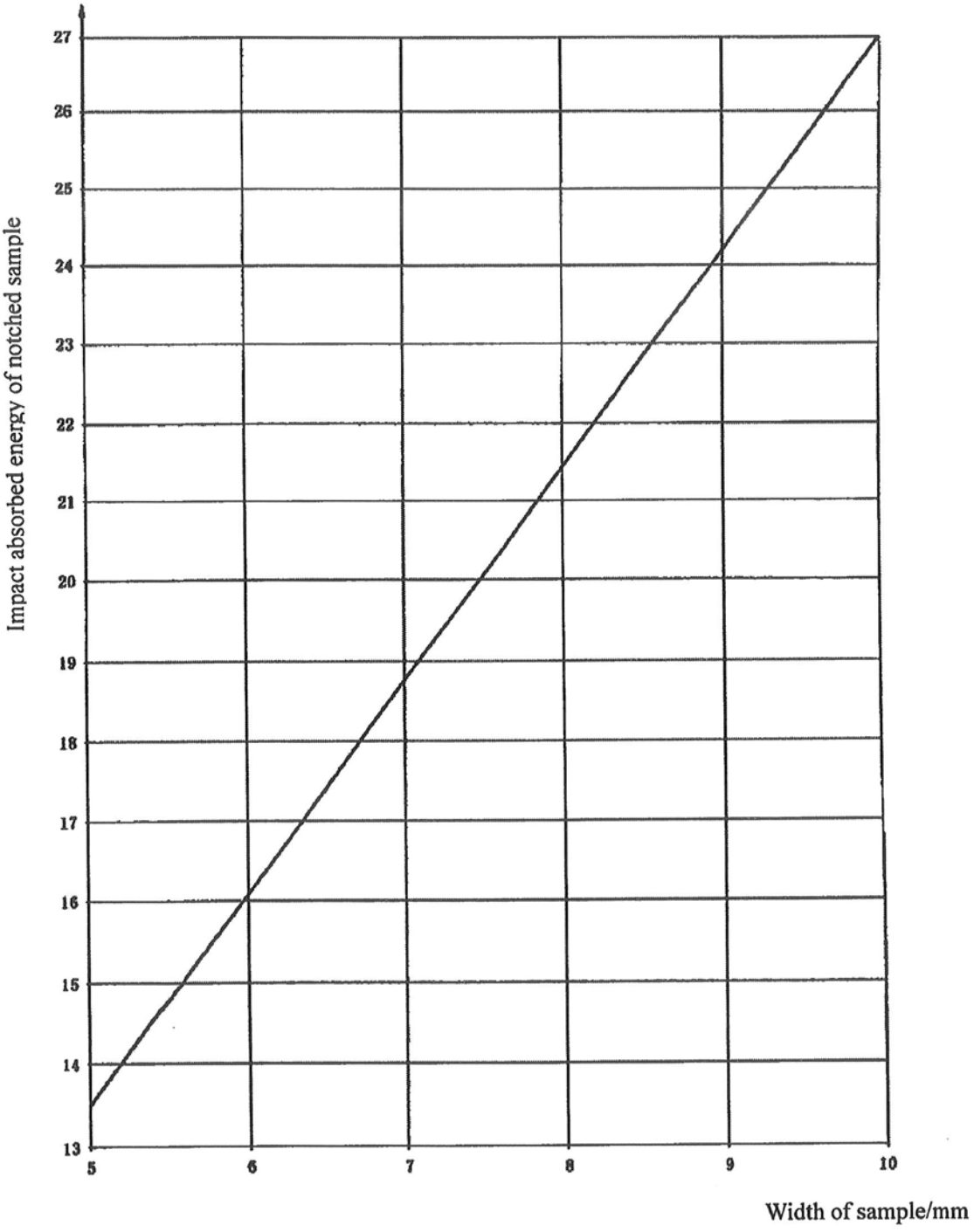

Figure A.1 Minimum impact absorbed energy of the samples of which the width is 5mm~10mm