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**NATIONAL STANDARD OF
THE PEOPLE'S REPUBLIC OF CHINA**

中华人民共和国国家标准

**GB/T 16270-2009
Replace GB/T 16270-1996**

**高强度结构用调质钢板
High strength structural steel plates in the
quenched and tempered condition**

a CodeofChina.com translation work
for your reference only

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Foreword

This standard is finished by referring to EN 10025-6: 2004 (E) "Hot rolled products of structural steels, Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition" and ISO 4950.3-2003 "high yield strength flat products, Part 3: quenched and tempered steel" and on the basis of production technology of domestic steel enterprise and through revising GB/T 16270-1996 "High-strength structural steel plates and strips: products supplied in the heat-treated or controlled rolled condition".

This standard replaces GB/T 16270-1996 "High-strength structural steel plates and strips: products supplied in the heat-treated or controlled rolled condition".

There have been some significant changes in this standard over JB/T 16270-1996 in the following aspects:

- Standard name is changed to "High strength structural steel plates in quenched and tempered condition";

- Applicable thickness is extended from 100mm to 150mm, steel strip is canceled ;

- Q420 is deleted, Q800, Q890 and Q960 three grades of steel and the corresponding technical indexes' specifications are added ;

- Quality grade C, F (except grade of steel Q460) are added, compositions and performances' specifications of every trademark are adjusted ;

- Specifications of flexural property are canceled ;

- Requirements of CEV are added and taking CET as the terms of consultation by both buyer and seller is supplemented;

- Such delivery states, as normalizing, normalizing + tempering, controlled rolling are deleted.

Appendix A for this standard is informative appendix.

This standard is proposed by China Iron & Steel Association.

This standard is under jurisdiction of China Steel Standardization Technical Committee.

This standard is drafted by Bao Steel Co., Ltd, China Metallurgical Information Standardization Research Institute, and LY Steel Co., Ltd.

This standard is prepared by Wang Xiangru, Zhou Shenyu, Wang Xiaohu, Wen Dezhi, and Zhoujian.

This national standard replaces the previous versions:

High strength structural steel plates in the quenched and tempered condition

1 Scope

This standard specifies designations, dimension, shape, weight, and allowable deviation, technical requirements, test method, test rules, packaging, marks and quality certificate of high strength structural steel plates in quenched and tempered condition.

This standard is applicable to high strength structural steel plate whose thickness shall not exceed 150mm and delivery state is slack quenching (quench plus tempering).

2 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this national standard. For dated reference, subsequent amendments (excluding correction) to, or revisions of, any of these publications do not apply. However, the parties who enter into agreement according to these specifications are encouraged to research whether the latest editions of these references are applied or not. For undated references, the latest edition of the normative document is applicable to this standard.

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

GB/T 223.5 Methods for chemical analysis of steel and alloy — The reduced molybdosilicate spectro-photometric method for the determination of acid-soluble silicon content

GB/T 223.9 Iron steel and alloy — Determination of aluminium content — Chrom azurol S photometric method

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 223.14 Methods for chemical analysis of iron, steel and alloy — The N-benzoyl-N-phenylhydroxylamine extraction photometric method for the determination of vanadium content

GB/T 223.16 Methods for chemical analysis of iron, steel and alloy — The chromotropic acid photometric method for the determination of titanium content

GB/T 223.17 Methods for chemical analysis of iron steel and alloy — The dianthylpyryl methane photometric method for the determination of titanium 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 223.23 Iron steel and alloy — Determination of nickel content — The dimethylglyoxime spectrophotometric method

GB/T 223.26 Iron steel and alloy — Determination of molybdenum content - The thiocyanate spectrophotometric method

GB/T 223.40 Iron steel and alloy — Determination of niobium content by the sulphochlorophenol S spectrophotometric method

GB/T 223.53 Methods for chemical analysis of iron, steel and alloy—The flame atomic absorption spectrophotometric method for the determination of copper content

GB/T 223.54 Methods for chemical analysis of iron, steel and alloy—The flame atomic absorption spectrophotometric method for the determination of nickel content

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 223.62 Methods for chemical analysis of iron, steel and alloy—The butyl acetate extraction photometric method for the determination of phosphorus 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 Iron steel and alloyed—Determination of manganese content—Flame atomic absorption spectrometric method

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 223.69 Methods for chemical analysis of iron, steel and alloy — The gas-volumetric method after combustion in the pipe furnace for the determination of carbon content

GB/T 223.76 Methods for chemical analysis of iron, steel and alloy—The flame atomic absorption spectrometric method for the determination of vanadium content

GB/T 223.78 Methods for chemical analysis of iron, steel and alloy — Curcumin spectrophotometric method for the determination of boron 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 pendulum impact test method (GB/T 229-2007, ISO 148-1: 2006, MOD)

GB/T 247 General Rule of Acceptance, Package, Mark and Certification for Steel Plates (Sheets) and Strips

GB/T 709 Dimension, Shape, Weight and Tolerances for Hot Rolled Sheets and Plates

GB/T 2970 Thicker Steel Plates - Method for Ultrasonic Inspection

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 spectrometry Spectrometric analysis of carbon and low-Alloy steel (Routine Method)

GB/T 14977 General requirement for surface condition of hot-rolled steel plates

GB/T 17505 Steel and steel products General technical delivery requirements

GB/T 20123 Steel and iron—Determination of total carbon and sulfur content Infrared absorption method after combustion in an induction furnace (routine method) (GB/T 20123—2006, ISO 15350 : 2000, IDT)

GB/T 20125 Low-alloy steel—Determination of multi-element contents—Inductively coupled plasma atomic emission spectrometric method

GB/T 20126 Unalloyed steel—Determination of low carbon content—Part 2: Infrared absorption method after combustion in an induction furnace (with preheating) (GB/T 20126-2006, ISO 15349-2: 1999, IDT)

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

YB/T 081 Rule for rounding off of numerical values and judgment of testing values for technical standards of metallurgy

3 Denomination methods of designation

Designation of steel was represented by the first letter of yield strength's Chinese pinyin, minimum yield strength numerical value, quality grade sign (C, D, E, F) the three parts were arranged in order.

Example: Q460E

Q—The first letter of Chinese pinyin of "屈" in Chinese language "屈服强度" ;

460—Specified minimum yield strength value, unit MPa;

E—Quality grade sign.

4 Information required when ordering

The customer shall provide the following information when ordering :

- a) This standard No.
- b) Designation;
- c) Dimension;
- d) Delivery state;
- e) Rim condition;
- f) Weight;
- g) Purpose;
- h) Other requirements.

5. Size, shape, weight and allowable deviation

5.1 Dimension, shape, weight and allowable deviation of steel plate shall comply with the specifications of GB/T709.

5.2 According to the agreement of both buyer and seller, the steel plate of other size, shape and allowable deviation can be provided.

6 Technical Requirements

6.1 Designation and chemical composition

6.1.1 Steel designation, chemical composition (heat analysis) and carbon equivalent value CEV shall comply with the specifications of Table 1.

6.1.2 According to the requirements of the buyer and through the negotiation of both buyer and seller and indicated in the contract, carbon equivalent value CET can be provided, $CET = C + (Mn + Mo) / 10 + (Cr + Cu) / 20 + Ni / 40$.

6.1.3 The allowable deviation of chemical composition of finished steel plate shall conform to

the provisions of GB/T 222.

6.2 Smelting process

By oxygen converter or electrosmelting.

6.3 Delivery state

Delivery of steel plate shall follow the state of slack quenching (quench+tempering).

6.4 Mechanical Properties and Processing Properties

6.4.1 The mechanical properties of steel plate and processing property shall meet the requirements of Table 2.

6.4.2 Charpy pendulum impact energy shall be calculated by arithmetic mean value of three specimens from one group, individual value of one specimen is below the specified value of Table 2, which is allowable, but the individual value shall not be below 70% of the specified value.

Table 1

Designation	Chemical composition ^{a,b} (mass fraction) /%, not more than															
	C	Si	Mn	P	S	Cu	Cr	Ni	Mo	B	V	Nb	Ti	CEV ^e		
														Product thickness /mm		
														≤50	>50~ 100	>100~ 150
Q460C Q460D Q460E Q460F	0.20	0.80	1.70	0.025	0.015	0.50	1.50	2.00	0.70	0.0050	0.12	0.06	0.05	0.47	0.48	0.50
Q500C Q500D Q500E Q500F	0.20	0.80	1.70	0.025	0.015	0.50	1.50	2.00	0.70	0.0050	0.12	0.06	0.05	0.47	0.70	0.70
Q550C Q550D Q550E Q550F	0.20	0.80	1.70	0.025	0.015	0.50	1.50	2.00	0.70	0.0050	0.12	0.06	0.05	0.65	0.77	0.83
Q620C Q620D Q620E Q620F	0.20	0.80	1.70	0.025	0.015	0.50	1.50	2.00	0.70	0.0050	0.12	0.06	0.05	0.65	0.77	0.83
Q690C Q690D Q690E Q690F	0.20	0.80	1.80	0.025	0.015	0.50	1.50	2.00	0.70	0.0050	0.12	0.06	0.05	0.65	0.77	0.83
Q800C Q800D Q800E	0.20	0.80	2.00	0.025	0.015	0.50	1.50	2.00	0.70	0.0050	0.12	0.06	0.05	0.72	0.82	—

Q800F																
Q890C	0.20	0.80	2.00	0.025	0.015	0.50	1.50	2.00	0.70	0.0050	0.12	0.06	0.05	0.72	0.82	—
Q890D																
Q890E				0.020	0.010											
Q890F																
Q960C	0.20	0.80	2.00	0.025	0.015	0.50	1.50	2.00	0.70	0.0050	0.12	0.06	0.05	—	0.82	—
Q960D																
Q960E				0.020	0.010											
Q960F																
a) As required, manufacturing plant can add one or more of alloy elements, maximum value shall conform to the specifications of this table and the contents shall be reported in the quality certificate. ° b) At least one refined grain element of Nb, Ti, V, Al shall be added to steel and at least one element's minimum shall be 0.015% (for Al is Als). Als can be replaced by Alt, the minimums is 0.018% at this time. c $CEV = C + Mn/6 + (Cr + Mo + V) / 5 + (Ni + Cu) / 15$°																

Table 2

Designation	Tensile testing ^a							Impact test			
	Yield strength			Tensile strength			Post-breaking extensibility A/%	Impact absorbtion energy (longitudinal)			
	R_{eH} /MPa, Not less than			R_m /MPa				KV_2 /J			
	Thickness/mm			Thickness/mm				Test temperature/°C			
	≤50	> 50~100	> 100~150	≤50	>50~100	> 100~150	0	-20	-40	-60	
Q460C	460	440	400	550~720		500~670	17	47	47	34	34
Q460D											
Q460E											
Q460F											
Q500C	500	480	440	590~770		540~720	17	47	47	34	34
Q500D											
Q500E											
Q500F											
Q550C	550	530	490	640~820		590~770	16	47	47	34	34
Q550D											
Q550E											
Q550F											
Q620C	620	580	560	700~890		650~830	15	47	47	34	34
Q620D											
Q620E											
Q620F											
Q690C	690	650	630	770~940	760~930	710~900	14	47	47	34	34
Q690D											
Q690E											
Q690F											

Q800C								34			
Q800D	800	740	—	840~1000	800~1000	—	13		34		
Q800E										27	
Q800F											27
Q890C								34			
Q890D	890	830	—	940~1100	880~1100	—	11		34		
Q890E										27	
Q890F											27
Q960C								34			
Q960D	960	—	—	980~1150	—	—	10		34		
Q960E										27	
Q960F											27
a) Tensile testing is applicable to transverse test-piece, impact test is applicable to longitudinal specimen.											
b) When yield phenomenon is not obvious, $R_{p0.2}$ can be adopted.											

6.4.3 If the steel plate's thickness is less than 12mm, auxiliary specimen shall be adopted for Charpy pendulum impact test of steel plate. If the thickness is between $>8\text{mm} \sim <12\text{mm}$, auxiliary specimen size of steel plate shall be 10mm * 7.5mm * 55mm, test result shall not be less than 75% of the specified value; If the thickness is between 6mm~8mm, auxiliary specimen size of steel plate shall be 10mm * 5mm * 55mm, test result shall not be less than 75% of the specified value. Impact test shall not be carried out for the steel plate whose thickness is less than 6mm.

6.5 Surface Quality

6.5.1 Flaw, bubble, scab, fold and inclusion etc. shall not be allowed for the steel plate surface. Lamination shall not be allowed for steel plate. If there are aforesaid defects, clearing can be allowed, clearing depth shall be calculated from the trim size of steel plate and shall not exceed thickness tolerance of steel plate, the minimum thickness of steel plate shall be ensured. Defect clearing position shall be smooth and no edges and corners.

6.5.2 Other defects can be allowed, but clearing depth shall be calculated from the trim size of steel plate and shall not exceed half of thickness allowable tolerance of steel plate, the defect position thickness shall be ensured not exceed the minimum thickness of steel plate.

6.5.3 Through negotiation by both buyer and seller and indicated in the contract, repair welding can be allowed for steel plate. If repair welding is carried out after quenching and tempering, quenching and tempering shall be carried out again.

6.5.4 Through negotiation by both buyer and seller and indicating in the contract, surface quality shall conform to specification of GB/T 14977.

6.6 Special Requirements

6.6.1 Through negotiation between buyer and seller and indicating in the contract, ultrasonic testing can be carried out for steel plate sheet by sheet, test method shall conform to specification of GB/T 2970, testing standard and acceptance grade shall be indicated in the contract.

6.6.2 Through negotiation between both buyer and seller and indicating in the contract, other special requirements can be put forward to the steel plate.

7 Test Methods

7.1 The inspection items, sample quantity, sampling methods and test methods of steel plates from every batch shall conform to the provisions of Table 3.

Table 3

Serial Number	Testing items	Sampling quantity	Sampling method	Test method
1	Chemical analysis ^a	1/furnace	GB/T20066	GB/T223、GB/T4336、GB/T20123、GB/T20125、GB/T20126
2	Stretch	1	GB/T2975	GB/T228
3	Impact	3	GB/T2975	GB/T229
4	Nondestructive test	Sheet by sheet or piece by piece	According to the provisions of nondestructive test standard	GB/T2970
a In the conduct of arbitration for chemical composition, GB/T 223 shall be used				

7.2 Visual inspection shall be applied to steel plate appearance.

8 Test Rules

The check and acceptance of steel plate shall be in charge of by the seller's technique quality monitoring department, and the buyer is entitled to check and inspect any of the testing items specified in this standard or contract.

8.2 Batch acceptance shall be carried out for steel plate. Each batch consists of steel plate with furnace No., same designation and specified value, same heat treatment system and the steel plate's thickness shall not exceed 5mm. The weight of each batch's steel plate shall not exceed 60t.

8.3 If the result of Charpy pendulum impulse testing doesn't meet the specification, three specimens shall be retaken as one group from the same batch's steel plate to be tested. Six specimen's average value before and after shall not be lower than the specified value of Table 2, two specimen under the specified value are allowable, but only one specimen is allowed to be under 70% of the specified value.

8.4 Recheck and determination of steel plate shall meet the specification of GB/T 17505.

9 Packaging, mark and quality certificate

The packaging, mark and quality certificate of steel plates shall conform to the provisions of GB/T 247.

10 Rounding off of numerical values

Rounding off of numerical values shall meet the specification of YB/T 081.

11 Approximate contrasts of designations from home and abroad

Approximate contrast among designations of this standard, primary standard, foreign or

international standard can see Appendix A.

Appendix A

(Informative Appendix)

Approximate contrasts of designations from home and abroad

Approximate contrasts among designations of this standard, primary standard, foreign or international standard can see table A.1.

Table A.1

This standard	GB/T 16270—1996	EN10025-6 : 2004 (E)	ISO 4950.3—2003
Q460QC	Q460C	—	—
Q460QD	Q460D	S460Q	E460DD
Q460QE	Q460E	S460QL	E460E
Q460QF	—	S460QL1	—
Q500QC	—	—	—
Q500QD	Q500D	S500Q	—
Q500QE	Q500E	S500QL	—
Q500QF	—	S500QL1	—
Q550QC	—	—	—
Q550QD	Q550D	S550Q	E550DD
Q550QE	Q550E	S550QL	E550E
Q550QF	—	S550QL1	—
Q620QC	—	—	—
Q620QD	Q620D	S620Q	—
Q620QE	Q620E	S620QL	—
Q620QF	—	S620QL1	—
Q690QC	—	—	—
Q690QD	Q690D	S690Q	E690DD
Q690QE	Q690E	S690QL	E690E
Q690F	—	S690QL1	—
Q800QC	—	—	—
Q800QD	—	—	—
Q800QE	—	—	—
Q800QF	—	—	—
Q890QC	—	—	—
Q890QD	—	S890Q	—
Q890QE	—	S890QL	—
Q890QF	—	S890QL1	—
Q960QC	—	—	—
Q960QD	—	S960Q	—
Q960QE	—	S960QL	—
Q960QF	—	—	—