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NATIONAL STANDARD

OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 1591-2008
Replacing GB/T *1591-1994*

High Strength Low Alloy Structural Steels

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Jointly issued by: General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China;

The Standardization Administration Committee of the People's Republic of China.

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Foreword

This standard is the revision to GB/T 1591-1994 "High Strength Low Alloy Structural Steels", with reference to EN 10025: 2004 "Structural Steel Hot Rolled Products".

This standard replaces GB/T 1591-1994 "High Strength Low Alloy Structural Steels".

Compared with GB/T 1591-1994, the main changes in this standard are as follows:

— Application range of the standard is expanded;

— Graded intensity scales of the Q500, Q550, Q620 and Q690 are added; and graded intensity scale of Q295 is deleted;

— The requirements of the chemical composition of the steel products are modified; and harmful elements such as phosphorus and sulfur are controlled more strictly;

— Calculation formula and requirements of the carbon equivalent and crack sensitivity coefficient of the steel products are added;

— Delivery state of the steel products is modified; and the requirements of the quenched and tempered steel are deleted;

— The requirements for mechanical properties and thickness class width of the steel products are modified; and lower yield strength is clearly defined as the yield strength;

— Impact absorption energy value is increased;

— Requirements for the thickness directional property of all graded steels are added.

This standard was proposed by China Iron & Steel Association.

This standard shall be under the jurisdiction of China Steel Standardization Technical Committee.

Drafting organizations of this standard: Angang Steel Co., Ltd.; China Metallurgical Information Standardization Research Institute; Jigang Group Co., Ltd.; Shougang Group; Jiangsu Shagang Group Co., Ltd., and Hunan Hualing Lianyuan Steel Co., Ltd.

Chief drafting staffs of this standard: LIU Xuyuan, PU Zhimin, WANG Xiaohu, GAO Ling, WANG Liping, HUANG Zhengyu, ZHOU Jian, MA Yupu, and CHEN Shuqin.

The previous versions replaced by this standard are:

— GB 1591-1979, GB 1591-1988 and GB/T 1591-1994.

High Strength Low Alloy Structural Steels

1. Scope

This standard specifies the high strength low alloy structural steels' grade, dimension, shape, weight, allowable deviation, technical requirements, test methods, test rules, packaging, mark, and quality certificate.

This standard is applicable to the steel plate, steel strip, section steel and steel bar of the high strength low alloy structural steels which are with general structure or are used for the engineering.

2. Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. For date reference, the subsequent amendments to (excluding amending error in the text) or revisions of, any of these publications do not apply. And parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. For undated references, its latest edition referred to applies.

GB/T 222 Allowable Deviation of Steel Product Analysis

GB/T 223.5 Iron and steel: reduced silicate spectrophotometric method for the determination of the acid soluble silicon and all silicon content

GB/T 223.9 Steel and alloy: the chrome azurol S spectrophotometric method for the determination of aluminum content;

GB/T 223.12 Chemical analysis method for steel and alloy: the sodium carbonate separation-diphenyl carbazide photometric method for the determination of chromium content

GB/T 223.14 Chemical analysis method for steel and alloy: the N-benzoy-N-phenylhydroxylamine extraction photometric method for the determination of vanadium content

GB/T 223.16 Chemical analysis method for steel and alloy: the chromotropic acid photometric method for the determination of titanium content

GB/T 223.19 Chemical analysis method for steel and alloy: the neocuproine-chloroform extraction photometric method for the determination of copper content

GB/T 223.23 Steel and alloy: the dimethylglyoxime spectrophotometric method for the determination of nickel content

GB/T 223.26 Steel and alloy: the thiocyanate spectrophotometric method for the determination of molybdenum content

GB/T 223. 37 Chemical analysis method for steel and alloy: the indophenol blue photometric method for the determination of nitrogen content after distillation separation;

GB/T 223. 40 Steel and alloy: the chlorsulphophenol S spectrophotometric method for the determination of niobium content;

GB/T 223. 62 GB/T 223.62 Chemical analysis method for steel and alloy: phosphorus quantity measured according to butyl acetate extraction-photometric method;

GB/T 223. 63 Chemical analysis method for steel and alloy: the sodium (potassium) periodate photometric method for the determination of manganese content

GB/T 223. 67 Iron and steel and alloy: the methylene blue spectrophotometric method for the determination of sulfur content

GB/T 223. 69 Iron and steel and alloy: the gas-volumetric method after combustion in the pipe furnace for the determination of carbon content

GB/T 223. 78 Chemical analysis method for steel and alloy: curcumin direct photometric 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 Metal material- Charpy pendulum impact test (GB/T 229-2007, ISO 148-1: 2006, MOD)

GB/T 232 Metal materials: bending test method (GB/T 232-1999, eqv ISO 7438:1985)

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

GB/T 2101 General Rule of Acceptance, Package, Mark and Certification for Section Steel

GB/T 2975 Steel and Steel Products-Mechanical Testing for Sampling Location and Specimen Preparation (GB/T *2975-1998*, eqv ISO 377: 1997)

GB/T 4336 Method for Photoelectric Emission Spectroscopic Analysis of Carbon Steel and Medium and Low Alloy Steel (conventional)

GB/T 5313 Through-thickness property steel plate (GB/T 5313-1985, eqv ISO 7778:1983)

GB/T 17505 Steel and steel products: general technical delivery requirements (GB/T 17505-1998, eqv ISO 404: 1992)

GB/T 20066 Steel and iron-sampling and preparation of samples for the determination of chemical composition (GB/T 20066-2006, 150 14284:1996, IDT)

GB/T 20125 Low alloy steel-inductively coupled plasma emission spectrometer for the determination of multielement content

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

3. Terms and Definitions

3.1 Thermomechanical rolling

The ultimate deformation is a rolling procedure, which is carried out within a certain temperature range. This procedure makes the material obtain the special performance which is not obtained only through heat treatment.

Note 1: If the temperature is increased to 580℃ after the rolling, the material strength value may be reduced. If it is necessary to increase the temperature to 580℃, it shall be supplied by the seller.

Note 2: Thermomechanical rolling delivery state may contain accelerated cooling or accelerated cooling plus tempering (contain self tempering), but excludes direct quenching or quenching plus tempering.

3.2 Normalizing rolling

The ultimate formation is a rolling procedure, which is carried out within a certain temperature range. This procedure makes the material obtain the performance which is equivalent to that after the normalizing.

4. Grade Representation

Steel grade is composed of three parts - Chinese phonetic alphabet, numerical value of the yield strength, and quality classification. For instance, Q345D; in which:

Q — is the first letter of the Chinese phonetic alphabet of the word "Qu" of the steel yield strength;

345 — is the numerical value of the yield strength (MPa);

D — is the quality classification; D grade.

When the buyer requires that the steel plate has through-thickness property, the symbol which stands for the grade of the through-thickness (Z direction) property shall be added and based on the aforesaid specified grade; for instance: Q345DZ15.

5. Dimension, Shape, Weight and Allowable Deviation

Dimension, shape, weight and allowable deviation shall meet the requirements of the corresponding standard.

6. Technical Requirements

6.1 Grade and Chemical Composition

6.1.1 Steel grade and chemical composition (heat analysis) shall meet the requirements of Table 1.

6.1.2 When the refined grain elements are needed to be added, there shall be at least one of four elements such as Al, Nb, V and Ti. The content of the added refined grain elements shall be marked in the quality certificate.

6.1.3 When it is expressed through the all-aluminum (Al_t) content, Al_t shall not be less than 0.020%.

6.1.4 The content of nitrogen element in the steel shall meet the requirements of Table 1. If it is determined by the seller, nitrogen element content may not be analyzed. If such alloy element (it is of nitrogen fixation) as Al, Nb, V and Ti are added into the steel, the nitrogen element content is not be restricted. The content of the nitrogen fixation element shall be marked in the quality certificate.

6.1.5 When Cr, Ni and Cu of each grade are taken as residual elements, their contents are not larger than 0.03% respectively. If it is determined by the seller, it may be exempted from analysis; when it needs to be added, the content shall meet the requirements of Table 1 or shall be agreed by the buyer and the seller.

6.1.6 To improve the performance of the steel, TE element may be added. And its addition shall be calculated according to 0.02% - 0.02% of the weight of liquid steel.

When the impact test result of steels doesn't meet the provisions of 6.4.2.3, the sampled steels shall not be accepted. Take another two products from the remained test part and sample three new specimens (consisting one group). The test results of the two groups of specimen shall be qualified; otherwise the batch of steels shall be rejected. The reinspection and determination of steels' tensile testing shall meet the requirements of GB/T 17505.

8.3.2 Reinspection and determination of other testing items

The reinspection and determination of steels' other testing items shall meet the requirements of GB/T 17505.

8.4 Rounding-off of the Test Results of Mechanical Properties and Chemical Composition

Unless otherwise stated in the contract or order sheet, when it is necessary to evaluate whether the test result can meet the specified value or not, the given test result of mechanical properties and chemical composition shall be rounded off in accordance with the specified value. The rounding-off method shall be carried out according to the provisions of YB/T 081. The carbon equivalent value shall be rounded off after being calculated according to the formula.

9. Packaging, Mark and Quality Certificate

The packaging, mark and quality certificate of the steels shall meet the provisions of GB/T 247 and GB/T 2101.

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