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High strength low alloy structural steels

低合金高强度结构钢

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High strength low alloy structural steels

1 Scope

This Standard specifies the designation representation method, ordering content, size, shape, weight, technical requirements, test methods, inspection rules, packaging, marking, and quality certificate of high strength low alloy structural steel.

This Standard is applicable to high strength low alloy structural steel plates, steel strips, steel sections, steel bars, etc. for general structural and engineering purposes. Its chemical composition is also applicable to steel billets.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this Standard.

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

GB/T 223.3 Methods for chemical analysis of steels and alloys - Determination of phosphorus content by diantipyryl methane phosphomolybdate gravimetric method

GB/T 223.9 Iron steel and alloy - Determination of aluminum content - Chrome azurol S photometric method

GB/T 223.11 Iron, steel and alloy - Determination of chromium content - Visual titration or potentiometric titration method

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 223.17 Methods for chemical analysis of steels and alloys – Diantipyryl methane photometric method for the determination of titanium content

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

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

GB/T 702 Hot-rolled round and square steel bars - Dimension, shape, weight and tolerance

GB/T 706 Hot-rolled section steel

GB/T 709 Dimension, shape, weight and tolerances for hot-rolled sheets and strip

GB/T 2101 General requirement of acceptance packaging marking and certification for section steel

GB/T 2975-2018 Steel and steel products - Location and preparation of samples and test pieces for mechanical testing

GB/T 4336 Carbon and low-alloy steel - Determination of multi-element contents - Spark discharge atomic emission spectrometric method (Routine method)

GB/T 5313 Steel plates with through-thickness characteristics

GB/T 8170 Rules of rounding off for numerical values & expression and judgement of limiting values

GB/T 11263 Hot-rolled H and cut T section steel

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 20066 Steel and iron - Sampling and preparation of samples for the determination of chemical composition

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 20124 Steel and iron - Determination of nitrogen content - Thermal conductimetric method after fusion in a current of inert gas

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

GB/T 28300 Surface quality classes for hot-rolled bars and rods technical delivery conditions

Note 1: Thermoforming that may reduce the steel strength value or steel post-weld heat treatment at temperatures above 580 °C may not be suitable. In accordance with the relevant technical specifications, flame straightening is allowed.

Note 2: Thermomechanical processing may include a process of increasing the cooling rate in a tempered or non-tempered state, the tempering includes self-tempering but not includes direct quenching and quenching & tempering.

Note 3: Also known as TMCP (thermomechanical controlled process), also referred to as “controlled rolling” in some publications.

4 Designation representation

4.1 The steel designation consists of four parts: the initial Pinyin Q of the yield strength “Qu”, the specified minimum upper yield strength value, the delivery status code, and the quality-grade symbol (B, C, D, E, F).

Note 1: When the delivery status is as-rolled, the delivery status code AR or WAR can be omitted; when the delivery status is normalized or normalizing rolling, the delivery status code is indicated by N.

Note 2: Q + The specified minimum upper yield strength value + delivery status code, abbreviated as “steel-grade”.

Example: Q355ND, where:

Q - The initials of the Chinese Pinyin “Qu” of the yield strength of steel;

355 - The minimum value of the specified upper yield strength, in megapascal (MPa);

N - The delivery status is normalizing or normalizing rolling;

D - The quality-grade is D.

4.2 When the purchaser requires the steel plate to have thickness-direction performance, a symbol representing the thickness direction (Z-direction) performance level, such as Q355NDZ25, is added after the above-mentioned specified designation.

5 Ordering content

5.1 Contracts or orders placed under this Standard shall include the following:

- a) This Standard number;

6.2 The size, shape, weight and allowable deviation of hot-rolled steel sections shall comply with the provisions of GB/T 706, the specific group shall be specified in the contract.

6.3 The size, shape, weight and allowable deviation of hot-rolled steel sheets and strips shall comply with the provisions of GB/T 709, the specific accuracy categories shall be indicated in the contract.

6.4 The size, shape, weight and allowable deviation of hot-rolled H-section steel and split T-section steel shall comply with the provisions of GB/T 11263.

6.5 Steels of other sizes, shapes and allowable deviations may be supplied upon agreement between the supplier and the purchaser.

7 Technical requirements

7.1 Steel designations and chemical composition

7.1.1 The designation and chemical composition of the hot-rolled steel (melting analysis) shall comply with the requirements of Table 1, the carbon equivalent value shall comply with the requirements of Table 2.

7.1.2 The designation and chemical composition of the normalized and normalized rolled steel (melting analysis) shall comply with the requirements of Table 3, the carbon equivalent value shall comply with the requirements of Table 4.

7.1.3 The designation and chemical composition of the thermomechanical processed steel (melting analysis) shall comply with the requirements of Table 5, the carbon equivalent value shall comply with the provisions of Table 6. When the carbon content of the thermomechanical processed steel is not greater than 0.12%, it should use the weld crack sensitivity index (Pcm) instead of the carbon equivalent to evaluate the weldability of the steel. The Pcm value shall meet the requirements of Table 6. After consultation between the supplier and the buyer, it may specify using the carbon equivalent or weld crack sensitivity index to evaluate the weldability of the steel; when it is not specified, the supplier may choose either one.

7.1.4 Carbon equivalent (CEV) is calculated from the smelting analysis component in accordance with formula (1). The weld crack sensitivity index (Pcm) is calculated from the smelting analysis component in accordance with formula (2):

$$CEV(\%) = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15 \dots\dots\dots(1)$$

$$Pcm(\%) = C + Si/30 + Mn/20 + Cu/20 + Ni/60 + Cr/20 + Mo/15 + V/10 + 5B \dots\dots\dots(2)$$

d) Heat treatment shall be carried out again after welding repair of heat treated steel plate.

7.5.1.5 After consultation between the supplier and the purchaser, the surface quality of the steel plate may also meet the requirements of GB/T 14977.

7.5.2 Steel strip and its cut steel plate

7.5.2.1 The surface of the steel strip shall be free of defects such as crusting, cracks, folding, inclusions, blisters and iron oxide indentation which are harmful to use. The steel strip shall not have visible delamination.

7.5.2.2 The surface of the steel strip is allowed to have a thin layer of iron oxide scale, rust and slight pitting, scratches and other partial defects. The depth or height shall not exceed half of the thickness tolerance of the steel strip, and it shall ensure the allowable minimum thickness of the steel strip.

7.5.2.3 The steel is allowed to be delivered with partial defects, but the defective portion shall not exceed 6% of the total length of each steel strip.

7.5.2.4 After consultation between the supplier and the purchaser, the surface quality of the steel strip may also meet the requirements of GB/T 14977.

7.5.3 Steel sections

7.5.3.1 The surface quality of steel sections shall comply with the provisions of relevant standards.

7.5.3.2 The surface quality of the steel sections may also follow the provisions of YB/T 4427 after consultation between the supplier and the purchaser.

7.5.4 Steel bars

7.5.4.1 The surface quality of steel bars should comply with the provisions of relevant standards.

7.5.4.2 After consultation between the supplier and the purchaser, the surface quality of the steel bar can be as specified in GB/T 28300.

7.6 Non-destructive testing

After consultation between the supplier and the purchaser, the internal quality of the steel may be inspected by non-destructive testing. The testing criteria and requirements shall be as specified in the contract.

8 Test methods

8.1 The inspection items and test methods for each inspection of steel shall

comply with the requirements of Table 13.

8.2 The chemical composition test of steel is generally carried out in accordance with GB/T 4336, GB/T 20123, GB/T 20124, GB/T 20125 or general chemical analysis methods. During arbitration, it is carried out in accordance with GB/T 223.3, GB/T 223.9, GB/T 223.11, GB/T 223.14, GB/T 223.17, GB/T 223.18, GB/T 223.23, GB/T 223.26, GB/T 223.37, GB/T 223.40, GB/T 223.60, GB/T 223.63, GB/T 223.68, GB/T 223.69, GB/T 223.76, GB/T 223.78, GB/T 223.84 and GB/T 20125.

8.3 When the purchaser has no special requirement, the sampling position of the impact test shall be as follows:

- a) For steel sections, it shall be in accordance with the provisions of Figure A.3 of GB/T 2975-2018;
- b) For round steel, when the nominal diameter $d \leq 25$ mm, $25 \text{ mm} < d \leq 50$ mm and $d > 50$ mm, it shall be respectively in accordance with the provisions of a), b), d) of Figure A.5 of GB/T 2975-2018;
- c) For square steel, when the side length is not greater than 50 mm, it shall be in accordance with the provisions of a) of Figure A.9 of GB/T 2975-2018; when the side length is greater than 50 mm, it shall be in accordance with the provisions of b) in Figure A.9 of GB/T 2975-2018;
- d) For steel plates, when the nominal thickness is not greater than 40 mm, it shall be in accordance with the provisions of a) in Figure A.11 of GB/T 2975-2018; when the nominal thickness is greater than 40 mm, it shall be in accordance with b) of Figure A.11 of GB/T 2975-2018.

9 Inspection rules

9.1 Inspection and acceptance

The inspection and acceptance of steel materials shall be carried out by the technical supervision department of the supplier.

9.2 Batching rules

9.2.1 Steel shall be accepted in batches. Each batch shall be composed of steel of the same designation, the same furnace-number, the same specification and the same delivery status. The weight of each batch shall not be greater than 60 t, however, two rolling coils of steel strip and continuous rolling sheet of volume-weight greater than 30 t may form a batch; for the steel sections smelted by converter with a volume greater than 200 t, the weight per batch shall be not greater than 80 t. Through negotiation between the supplier and the purchaser,

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Contact: Wayne Zheng, Sales@ChineseStandard.net

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