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GB/T 3077-2015

Replacing GB/T 3077-1999

Alloy Structure Steels

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Foreword

This Standard is drafted in accordance with the rules specified by GB/T 1.1-2009.

This Standard replaces GB/T 3077-1999 "alloy structure steel".

Compared with GB/T 3077-1999, the main technical changes of this Standard are as follows:

- MODIFY the classification requirements based on metallurgical quality (see Table 2, Table 4,6.7 and 6.8 of this version; Table 2 and Table 4 of 1999 version);

- ADJUST the lower limit of boron steel's B content from 0.0005% to 0.0008% (see Table 1 of this version);

- DELETE all designations with letter "A"; however, the chemical composition of same designation is adjusted to the chemical composition of the original designation with letter A (see Table 1 of this version; Table 1 of 1999 version);

- ADD 12 designations and related technical requirements, such as 25MnB, 35MnB, 25CrMo, 50CrMo, 34CrNi2,15CrNiMo, 30CrNiMo, 30Cr2Ni2Mo, 30Cr2Ni4Mo, 34Cr2Ni2Mo, 35Cr2Ni4Mo, 40CrNi2Mo (see Table 1 and Table 3 of this version; Tables 1 and 3 of 1999 version);

- ADJUST the sulfur and phosphorus content of steel (Table 2 of this version; Table 2 of 1999 version);

- SUBDIVIDE the surface defects into defect and deficiency (see 6.10 of this version; 6.6 of 1999 version);

- MODIFY the surface quality description, and INCLUDE GB/T 28300 standard specifications (see 6.10 of this version; 6.6 of 1999 version);

- MODIFY the "nonmetallic inclusion" requirements (see 6.7 of this version; 6.9 of 1999 version);

- ADD "grain size" requirements (see 6.8 of this version);

- MODIFY "special requirements" (see 6.11 of this version; 6.10 of 1999 version);

- ADD the numerical rounding requirements (see 7.2 of this version);

- ADD the comparison table of this Standard's designations and foreign

Alloy Structure Steels

1 Scope

This Standard specifies the classification and code, order content, size, shape, weight and allowable tolerance, technical requirements, test method, inspection rules, packaging, marking and quality certificate of alloy structure steel.

This Standard applies to the hot-rolled and forged alloy steel bars which are not more than 250mm of nominal diameter or thickness. However, after negotiated by the Supplier and Demander, it is also allowed to supply hot-rolled and forged alloy steel bars which are more than 250mm of nominal diameter or thickness (abbreviated as the steel bar).

The designations and chemical compositions which are specified in this Standard are also applicable to steel ingot, billet and their products.

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 223.4 Alloyed steel - Determination of manganese content - Potentiometric or visual titration method

GB/T 223.5 Steel and iron - Determination of acid-soluble silicon and total silicon content - Reduced molybdosilicate spectrophotometric method

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

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

GB/T 223.13 Methods for chemical analysis of iron, steel and alloy - The ammonium ferrous sulfate titration 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 223.18 Methods for chemical analysis of iron, steel and alloy - The sodium thiosulfate separation iodimetric method for the determination of copper content

GB/T 223.23 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 223.43 Iron, steel and alloy - Determination of tungsten content - Gravimetric method and spectrophotometric method

GB/T 223.49 Methods for chemical analysis of iron, steel and alloy - Extraction separation - Chlorophosphonazo mA spectrophotometric method for the determination of the total rare earth content

GB/T 223.59 Iron, steel and alloy - Determination of phosphorus content - Bismuth phosphomolybdate blue spectrophotometric method and antimony phosphomolybdate blue spectrophotometric method

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 223.67 Iron, steel and alloy - Determination of sulfur content - Methylene blue spectrophotometric method

GB/T 223.69 Iron, steel and alloy - Determination of carbon contents - Gas-volumetric method after combustion in the pipe furnace

GB/T 223.75 Iron, steel and alloy - Determination of boron content - Methanol distillation-curcumin photometric method

GB/T 224 Determination of depth of decarburization of steels

GB/T 225 Steel - Hardenability test by end quenching (Jominy test)

GB/T 226 Test method for macrostructure and defect of steel by etching

GB/T 228.1 Metallic materials - Tensile testing - Part 1: Method of test at room temperature

GB/T 229 Metallic materials - Charpy notch impact test

GB/T 231.1 Metallic materials - Brinell hardness test - Part 1: Test method

GB/T 702 Hot-rolled steel bars - Dimensions, shape, weight and tolerance

GB/T 908 Forged bars - Dimensions, shape, weight and tolerance

GB/T 1979 STANDARD diagrams for macrostructure and defect of structural steels

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

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

GB/T 4162 Forged and rolled steel bars - Method for ultrasonic testing

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

GB/T 6394 Metal - Methods for estimating the average grain size

GB/T 6402 Steel forgings - Method for ultrasonic testing

GB/T 7736 Ultrasonic inspecting method for macro-structure and imperfection of steel

GB/T 8170-2008 Rules of rounding off for numerical values & expression and judgment of limiting values

GB/T 10561 Steel - Determination of content of nonmetallic inclusions - Micrographic method using standards diagrams

GB/T 11261 Steel and iron - Determination of oxygen content - The pulse heating inert gas fusion-infra-red absorption method

GB/T 13298 Inspection methods of microstructure for metals

GB/T 13299 Steel - Determination of microstructure

GB/T 15711 Steel products - Method for etch test of tower sample

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 21834 Medium and low alloy steel - Determination of the distribution of multi-element contents - Original position statistic distribution analysis method

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

YB/T 4306 Steel, iron and alloy - Determination of nitrogen content - Thermal conductimetric method after fusion in a current of inert gas

YB/T 5293 Metallic materials - Forging test

3 Classification and code

3.1 Based on metallurgical quality, the steel bar is divided into the following three categories:

a) Quality steel;

b) Advanced-quality steel (ADD "A" after designation);

c) Excellent-quality steel (ADD "E" after designation).

3.2 Based on application and processing method, the steel bar is divided into the following two categories:

a) Steel for pressure processing UP;

1) Hot pressure processing UHP;

2) Upsetting steel UF;

3) Cold drawn blank UCD;

b) Cutting steel UC.

3.3 Based on surface types, the steel bar is divided into the following five categories:

a) Pressure processing surface SPP;

b) Pickling SA;

c) Shot blasting (sand blasting) SS;

d) Stripping SF;

e) Polishing SP.

4 Ordering content

In accordance with this Standard, the order contract or order shall include the following:

a) Standard number;

b) Product name;

c) Designations OR unified digit code;

d) Controlled residual elements (if required, see Table 2);

e) Delivery weight (or quantity);

f) Size, shape and allowable tolerance;

g) Processing method used (if not indicated, it is deemed as cutting steel);

h) Heat treatment delivery or special surface state delivery (if required, see 6.3.2 and 6.3.3);

i) Hot upsetting (if required, see 6.5);

j) Decarburization (if required, see 6.9);

k) Special requirements (if required, see 6.11).

5 Size, shape, weight and tolerance

5.1 The size, shape, weight, and allowable tolerance of hot-rolled steel bar shall comply with the relevant provisions of GB/T 702; the specific requirements shall be indicated in the contract.

5.2 The size, shape, weight, and allowable tolerance of hot-forged steel bar shall comply with the relevant provisions of GB/T 908; the specific requirements

shall be indicated in the contract.

5.3 The size, shape, weight, and allowable tolerance of other-sized steel bar shall comply with corresponding standards OR otherwise negotiated by the Demander and Supplier; the specific requirements shall be indicated in the contract.

6 Technical requirements

6.1 Designation and chemical composition

6.1.1 The steel designation, unified digit code and chemical composition (melting analysis) shall comply with the requirements in Table 1.

6.1.2 The sulfur, phosphorus and residual element contents in steel shall be in accordance with Table 2.

6.1.3 The allowable tolerance of finished bar's (or blank's) chemical composition shall comply with the provisions of GB/T 222.

Table 2 Phosphorus, sulfur and residual element content in steel

Quality grades of steel	Chemical composition (mass fraction) /%, not more than					
	P	S	Cu[a]	Cr	Ni	Mo
Quality steel	0.030	0.030	0.30	0.30	0.30	0.10
Advanced-quality steel	0.020	0.020	0.25	0.30	0.30	0.10
Excellent-quality steel	0.020	0.010	0.25	0.30	0.30	0.10
It shall ANALYZE the residual tungsten, vanadium, titanium content in steel; RECORD the results in the quality certificate. Based on the Demander's requirements, it is allowed to limit the residual tungsten, vanadium and titanium content.						
[a] The copper content in the steel which is used for hot pressure processing shall not be more than 0.20%.						

6.2 Melting method

Unless otherwise specified in the contract, the smelting method is to be selected by the manufacturer itself.

6.3 Delivery status

6.3.1 The steel bar is generally delivered under hot-rolled OR hot-forging state.

6.**3.2** Based on the Demander's requirements AND indicated in the contract, it is also allowed to make delivery under heat treatment (annealing, normalizing or tempering) state.

6.3.3 If it is agreed by the Demander and Supplier AND indicated in the contract, it is allowed to deliver the steel bar with the surface polished, peeled or finished otherwise.

6.4 Mechanical properties

6.4.1 After the sample blank is subject to the heat treatment system processing which is recommended in Table 3, the steel bar's measured longitudinal mechanical properties shall comply with the requirements in Table 3.

6.4.2 The mechanical properties listed in Table 3 are applicable to the steel bars which is not more than 80mm of nominal diameter or thickness. As for the steel bars which are more than 80mm of nominal diameter or thickness, the mechanical properties shall meet the following requirements:

a) As for the steel bar which is more than 80mm ~ 100mm of nominal size, it is allowed to reduce its fractured elongation, percentage reduction of area, and impact energy absorption for 1% (absolute value), 5% (absolute value) and 5% respectively, as compared with Table 3;

b) As for the steel bar which is more than 100mm ~ 150mm of nominal size, it is allowed to reduce its fractured elongation, percentage reduction of area, and impact energy absorption for 2% (absolute value), 10%

8.2.1 The steel bar shall be checked and accepted based on batches. AND each batch is composed of bars of same designation, same heat number, same processing methods, same size, same delivery status, and same heat treatment system (or heat).

8.2.2 As for the steel subject to electroslag re-melting smelting, under the conditions of guaranteeing stable process AND each requirement of this Standard, it is allowed to conduct batching and delivery based on the consumable electrode melting furnace number.

8.3 Sample amount and sampling location

The sample amount and location of each batch of the steel bars shall comply with Table 8.

8.4 Re-inspection and judgment rules

8.4.1 The steel bars shall be subject to re-inspection and judgment in accordance with GB/T 17505.

8.4.2 If the Supplier can guarantee the steel bar qualification, as for the test results of the mechanical property, macrostructure, nonmetallic inclusion of the steel bars or billets of same heat number, it is allowed to use blank to substitute material, AND use big to substitute small.

8.4.3 As for the inspection and test results of steel bars, it shall use rounding value comparison method to round them to the marked digit which is consistent with the specified value's basic digit, AND the rounding off rules shall comply with Chapter 3 of GB/T 8170-2008.

9 Packaging, marking and quality certificate

The packaging, marking and quality certificate of steel bars shall comply with GB/T 2101.

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