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NATIONAL STANDARD

OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 5216-2004

Replace GB/T 5216-1985

Structural Steels Subject to End-quench Hardenability Requirements

保证淬透性结构钢

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Foreword

This standard replaces GB/T 5216-1985 “Technical Requirements for Structural Steel with Specified Hardenability Bands”.

Compared with GB/T 5216-1985, the main changes of this standard are as follows:

- Change the standard name to “Structural Steels Subject to End-quench Hardenability Requirements";

- Add the sections “Normative References”, “Order Contents” and “Smelting Process” etc.;

- In Article 6.3, add “according to the agreement of the supply and purchaser about the delivery, the surface of the round steel used for press working may adopt turning, peeling or other finishing methods”;

- The grades are increased to 24 from 15 (excluding half free cutting steel). Add the 11 grades - 15CrH, 20Cr1H, 15CrMoH, 20CrMoH, 22CrMoH, 42CrMoH, 16CrMnH, 20CrMnH, 15CrMnBH, 17CrMnBH, and 20CrNi2MoH. Delete the 2 grades - 20MnMoBH and 22MnVBH. And add the unified numbering of the grades;

- Tighten the content requirements of residual elements such as sulphur, phosphorus, chromium, nickel and copper;

- The hardenability bands are classified into H, HH and HL bands from the primary one band. Add "The supply methods of end-quench hardenability may adopt actual measurement and calculation according to the formula”;

- Delete the “impression diameter “in Table 3; the primary Articles 3.1.3, 3.1.5, 3.3.2 and 3.4.2; as well as the requirements in relation to “fracture inspection ";

- Change the “segregation” in primary Article 3.6.2 into “Ingot case segregation”. The Ingot case segregation of the high quality steel is changed from Grade 2.5 into Grade 2;

- Change the primary Article 3.7.1 “Inspection for the non-metallic inclusions in steel" from agreement item into basic guarantee item. Specify the qualification grades according to Classes A, B, C and D;

- Change the primary Article 3.7.2 into “the austenite grain size of the steel is not less than Grade 5”;

- Change “c. Test for impact ductility of non-boron-contained steel” to “c. Test for mechanical property”. And add “Test for oxygen content of steel”;

- Add the hardenability curve of the 11 newly-added grades. And delete the hardenability

Structural Steels Subject to End-quench Hardenability Requirements

1 Scope

This standard specifies the steel dimensions, shape, weight and permissible tolerances, technical requirements, test methods, inspection rules, packaging, sign and quality certificate etc. of the hot rolling and hot forging structural steels subject to end-quench hardenability requirements.

This standard is applicable to the hot rolling and forging structural steel bars of hardenability used in machinery manufacture with its diameter or thickness no less than 30 mm. The steel hardenability is determined by edge quenching or calculated by the formula.

2 Normative References

The following documents contain provisions which, through reference in this text, constitute provisions of this standard. For dated references, subsequent amendments to (excluding amending corrigendum), or revisions of, any of these publications do not apply. However, all parties who have reached an agreement according to this standard are encouraged to study whether the latest edition of these documents is applicable. For undated references, the latest edition of the normative document is applicable to this standard.

GB/T 222-1984 Method of Sampling Steel for Determination of Chemical Composition and Permissible Variations for Product Analysis

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 223.5 Methods for Chemical Analysis of Iron, Steel and Alloy - The Reduced Molybdosilicate Spectro - Photometric Method for the Determination of Acid - Soluble Silicon 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 223.14 Methods for Chemical Analysis of Iron, Steel and Alloy - The N-Benzoy-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 Diantipyryl Methane Photometric Method for the Determination of Titanium Content

GB/T 223.18 Methods for Chemical Analysis of Iron, Steel and Alloy - The Neocuproine-Chloroform Extraction Photometric 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 223.23 Iron, Steel and Alloy - Determination of Nickel Content - The Dimethylglyoxime Spectrophotometric Method

GB/T 223.24 Methods for Chemical Analysis of Iron, Steel and Alloy - The Extraction Separation - The Dimethylglyoxime Spectrophotometric Method for the Determination of Nickel Content

GB/T 223.25 Methods for Chemical Analysis of Iron, Steel and Alloy - The Dimethylglyoxime Gravimetric Method for the Determination of Nickel Content

GB/T 223.26 Iron, Steel and Alloy - Determination of Molybdenum Content - The Thiocyanate Spectrophotometric Method

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 223.54-1987, eqv ISO 4940:1985, Steel and cast iron - Determination of nickel content - Flame-atomic: absorption spectrophtometric method)

GB/T 223.58 Methods for Chemical Analysis of Iron, Steel and Alloy - The Extraction - Absorption Catalytic Polarographic Method for the Determination of Manganese Content

GB/T 223.59 Methods for Chemical Analysis of Iron, Steel and Alloy - The Sodium Arsenite - Sodium Nitrite Titrimetric 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 223.61 Methods for Chemical Analysis of Iron, Steel and Alloy - The Ammonium Phosphomolybdate Volumetric Method for the Determination of Phosphorus 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 Iron, Steel and Alloy - Determination of Carbon Contents - Gas-Volumetric Method after Combustion in the Pipe Furnace

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 - Bar-Ium Sulfate Gravimetric Method for the Determination of Sulphur Content

GB/T 223.75 Iron, Steel and Alloy - Determination of Boron Content - Methanol Distillation-Curcumin Photometric Method

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 225 Steel - Hardenability Test by end-quenching (Jominy Test) (GB/T 225-1988, eqv ISO 642:1979)

GB/T 226 Steel - Hardenability Test by end-quenching (Jominy Test) (GB/T 226-1991, Neq ISO 4969:1980, Steel - Macroscopie Examination by Etching with Strong Mineral Acids)

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, Steel - Charpy Impact Test (U-Notch), Eqv ISO 148:1983, Steel - Charpy Impact Test (V-Notch))

GB/T 231.1 Metallic Materials - Brinell Hardness Test - Part 1: Test Method (GB/T 231.1-2002, eqv ISO 6506-1:1999)

GB/T 233 Metallic Materials - Forging Test

GB/T 702 Hot-Rolled Round and Square Steels - Dimension, Shape, Weight and Tolerance

GB/T 908 Forged Round and Square Steels - Dimension, Shape, Weight and Tolerance

GB/T 1979 Standard Diagrams for Macrostructure and Defect of Structural Steels

GB/T 2101 General Requirements 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 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 6394 Metal - Methods for Estimating the Average Grain Size

GB/T 7736 Ultrasonic Inspecting Method for Macro - Structure and Imperfection of Steel

GB/T 10561 Steel - Determination of Content of Non-Metallic Inclusion - Micrographic Method Using Standard Diagrams (GB/T 1056-1989, eqv ISO 4967:1979, Steel - Determination of Content of Nonmetallic Inclusions—Micrographie Method Using Standard Diagrams)

GB/T 11261 Methods for Chemical Analysis of High Carbon Chromium Bearing Steel - The Pulse Heating Inert Gas Fusion - Infra-Red Absorption Method for the Determination of Oxygen Content

GB/T 13299 Steel - Determination of Microstructure

GB/T 15711 Steel Products - Method for Each Test of Tower Sample (GB/T 15711-1995, neq ISO 3763:1976, Wrought Steels - maeroscopic Methods for Assessing the Content of Non-metallic Inclusions)

GB/T 17505 Steel and Steel Products - General Technical Delivery Requirements (GB/T 17505-1998, eqv ISO 404:1992)

GB/T 17616 Unified Numbering System for Grades of Iron, Steel and Alloy

3 Order Contents

The order contract or the order according to this standard shall include the following content:

a) Standard number;

b) Product name;

c) Grade or unified numbering;

13	20CrNiMoH	197

6.4.2 If the grade is not listed in Table 3 in the delivery state of annealing or high tempering, the hardness of the steel under delivery state shall be determined by the negotiation between supply and purchaser.

6.5 End-quench hardenability

6.5.1 The end-quench hardenability of steel is determined by actual measurement, and may also adopt calculation method according to the formula as agreed between the supply and purchaser. The calculation method is determined by the negotiation between the supply and purchaser, or referring to the methods provided in Appendix A.

6.5.2 The hardenability band of steel and the hardness value of its points shall meet those specified in Figure 2~25 and corresponding Tables.

6.5.3 The normalizing temperature range, end-quenching temperature and permissible variation of determining hardenability sample shall meet those specified in Figure 2~25 and corresponding Tables.

6.5.4 Hardness less than HRC 20 is not formulated.

6.6 Hardenability order methods

6.6.1 The order may be in any kind of methods according to the following requirements, and shall be indicated in the contract:

Method A: The maximum and minimum hardness values, apart from certain distance of quenched end, are shown in Figure 1's H band's A~A'; and indicated by H band $J\frac{34-45}{9}$.

Method B: The maximum and minimum hardness values, apart from certain distance of quenched end; and the maximum or minimum hardness values, apart from another certain distance, are shown in Figure 1's H band's A~A'+B (or B); and indicated by H band $J\frac{34-45}{9}+J\frac{\leq 39}{15}(or\,J\frac{\geq 28}{15})$.

Method C: The maximum and minimum hardness value, apart from the 2 quenched ends, are shown in Figure 1's H band's A~A' + B~B'; and indicated by H band $J\frac{34-45}{9}+J\frac{28-39}{15}$. It may also order according to H band's A~A' + B (or B') + C (or C'), and indicated by H band $J\frac{34-45}{9}+J\frac{\leq 39}{15}(or\,J\frac{\geq 28}{15})+J\frac{\leq 34}{25}(or\,J\frac{\geq 23}{25})$.

Method D: Order according to hardenability band. The hardenability of steel shall be in

15	Surface	Stick by stick	Integral steel bar	Visual
[a] When the delivery steels are less than three pieces, the hardness is measured according to the actual steels.				

8 Inspection Rules

8.1 Inspection and acceptance

8.1.1 The ex-factory inspection and acceptance of the steels shall be carried out by the quality and technical supervision department of the supplier.

8.1.2 The supplier must ensure that the delivery steels meet the provisions of this standard or contract. The purchaser has the right to carry out inspection and acceptance of any inspection-items specified in this standard or the contract.

8.2 Batch-group rules

The inspection and acceptance of the steels shall be carried out in batch. The steels with same homogeny furnace number, same homogeny processing method, same size, same homogeny delivery state, and same homogeny heat treating regime (heat) are deemed as 1 batch.

8.3 Sampling quantity and sampling location

The Sampling quantity and sampling location of each batch steels shall be in accordance with those specified in Table 8.

8.4 Reinspection and criterion rule

8.4.1 The reinspection and criterion rule of the steels shall be executed according to the provision of GB/T 17505.

8.4.2 If the supplier can ensure that the steels are qualified, FOR macrostructure, non-metallic inclusion and end-quench hardenability of the steels or steel billet that are from the same furnace number, it is allowed to replace steels with billet; and replace the larger one with the smaller one.

9 Packaging, Marking and Quality Certificate

The packing, marking and quality certificate of steels shall be in accordance with those specified in GB/T 2101.

Appendix B

(Informative)

Comparison Table of Newly-added Grades Listed in Table 1 of This Standard with Overseas Grades

B.1 Comparison Table of newly-added grades listed in Table 1 of this standard with overseas grades is detailed in Table B.1.

Table B.1

Number (in Table 1)	Grade (in GB/T 5216)	Corresponding foreign grade	Foreign standard
2	15CrH	SCr415H	Japan JIS G4052—1979
4	20Cr1H	SCr420H	Japan JIS G4052—1979
7	16CrMnH	16MnCr5	German DIN EN 10084—1998
8	20CrMnH	20MnCr5	German DIN EN 10084—1998
9	15CrMnBH	ZF6	
10	17CrMnBH	ZF7	
15	15CrMoH	SCM415H	Japan JIS G4052—1979
16	20CrMoH	SCM420H	Japan JIS G4052—1979
17	22CrMoH	SCM822H	Japan JIS G4052—1979
18	42CrMoH	SCM440H	Japan JIS G4052—1979
24	20CrNi2MoH	SAE4320	America SAE J1268—1995

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