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

GB/T 33160-2016

Gear steel for wind power generation

风力发电用齿轮钢

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Foreword

This Standard was drafted as per the rules specified in GB/T 1.1-2009. This Standard was proposed by China Iron and Steel Industry Association. This Standard shall be under the jurisdiction of National Technical Committee for Standardization of Steel (SAC/TC 183).

Drafting organizations of this Standard. Zhejiang Weicheng Holding Co., Ltd., Xining Special Steel Co., Ltd., and Fushun Special Steel Co., Ltd. Chief drafting staffs of this Standard. Miao Zhigang, Xin Donghui, Gao Sheng, Wang Hailong, Chen Qingxin, Yu Gaoxing, Li Hailong, Liang Guangshu, and Ji Xiao. Gear Steel for Wind Power Generation

1 Scope

China's national standard for the steel from which wind turbine gears are made. It specifies the ordering contents, the dimensions and shape, the technical requirements, the test methods, the inspection rules, and the packaging, marking and quality certificate, and it applies to hot-forged bar used for making wind power generation gears, with an informative annex giving the hardenability band and the hardness values at each point. A wind turbine gearbox is one of the hardest duties in mechanical engineering. It sits several dozen metres up a tower, it is expected to run for twenty years, and replacing it means bringing a crane large enough to lift a gearbox to a site chosen for its wind rather than its access. It is also loaded in a way that laboratory fatigue testing struggles to reproduce: the torque is not steady but fluctuates with every gust and every blade passage, and the drive train sees torque reversals during starts, stops and grid events. So the steel has to be exceptionally clean and exceptionally consistent. Cleanness matters because a gear tooth fails from a subsurface inclusion at the depth of maximum shear stress, and an oxide particle a few tens of microns across is enough to start it. Consistency matters because the tooth is

case-carburised, and the case depth and core strength that a heat treatment produces depend on the hardenability of the steel - which is why the hardenability band, given in the annex, is the defining characteristic of the product rather than an accessory to it. Issued on 13 October 2016 and in force since 1 September 2017.

This Standard specifies the ordering contents, dimension, shape, technical requirements, test methods, inspection rules, package, mark, and quality certificate, etc. of the gear steel for wind power generation. This Standard is applicable to the hot-forging bar (hereinafter referred to as bar), which is used for making the gear steel for wind power generation.

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 document.

GB/T 222 Permissible Tolerances for Chemical Composition of Steel Products

GB/T 223.9 Iron Steel and Alloy - Determination of Aluminium 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 223.14 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 223.19 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 223.59 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 223.63 Methods for Chemical Analysis of Iron, Steel and Alloy - The Sodium

(Potassium) Periodate Photometric Method for the Determination of Manganese Content

GB/T 223.68 Methods for Chemical Analysis of Iron Steel and Alloy -The Combustion Potassium Iodate Volumetric Method for the Determination of Sulfur Content

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 223.84 Steel and Iron - Determination of Titanium Content - Dinitiopyrilmethane Spectrophotometric Method

3 Ordering Contents

The ordering contract or ordering form shall include the following contents according to this Standard.

- a) Standard number;
- b) Product name;
- d) Delivery state;
- e) Dimension and accuracy;
- f) Smelting method;
- g) Surface state (see Sub-clause 5.4.2);
- h) Delivery quantity (or weight);
- i) Hardenability (see Sub-clause 5.6);

7.1.1 The exit-factory inspection and acceptance of bar shall be performed by the Quality Technical Supervision Department of the supplier.

7.1.2 The supplier shall ensure the delivered bars to conform to the provisions of this Standard or contract; the purchaser shall have the right to perform inspection and acceptance against any inspection item specified by this Standard or contract.

7.2 Batching rules The bars shall be performed inspection and acceptance as per batch; each batch consists of the bars with the same grade, the same furnace number, the same surface state, the same dimension, the same delivery state, and the same heat treatment system (heat).

7.3 Sampling quantity and sampling position The sampling quantity and sampling position of each batch of bars shall conform to the provisions of Table 6.

7.4 Re-inspection and judgment rules

7.4.1 The re-inspection and judgment rules of bar shall be performed as per the provisions

of GB/T 17505.

7.4.2 The inspection and testing results of bar shall be rounded off, by adopting rounding value comparison method, to the same numerical digit marked by the standard digit of specified value; the rounding off rules shall conform to the provisions of Clause 3 in GB/T 8170-2008.

7.4.3 If the supplier can guarantee the steel qualified, the inspection results on macrostructure, non-metallic inclusion and hardenability of bar with the same furnace number are allowed to replace the small one by the large one.