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

GB/T 33084-2016

Heavy alloy structural steel forgings - Technical specification

大型合金结构钢锻件 技术条件

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1 Scope

China's national technical specification for heavy alloy structural steel forgings - the companion to GB/T 33083 and the more demanding of the pair, covering the large forgings made from alloy rather than plain carbon steel: the turbine and generator rotors, the heavy shafts, the press columns, the mill rolls and the pressure-retaining pieces where the section is too great, or the duty too severe, for a carbon steel to develop the properties required through its thickness. The standard specifies the ordering requirements, the manufacturing process, the technical requirements, the inspection rules and test methods, the acceptance and quality certificate, and the marking and packaging of alloy structural steel forgings for

general use in mechanical products, and it applies to their ordering, manufacture and inspection. The reason alloy steel is used at all in this size is hardenability: on a heavy section a plain carbon steel simply cannot be cooled fast enough at the centre to transform properly, so the properties fall away from the surface inwards, and the alloying elements are added to shift that limit. Everything else in the standard follows: the tighter control of the chemical composition, the specification of the forging reduction and of the heat treatment on which the through-thickness properties depend, the strictly limited conditions for repair welding, the mechanical properties tabulated by grade and by section size rather than by grade alone, the hardness, and the non-destructive testing which on these pieces is the only means of knowing what is at the axis. The inspection clause again fixes where the test specimens are taken from each form of forging, and sets the retest and re-heat treatment provisions, before the acceptance, the quality certificate and the marking and packaging. Issued on 13 October 2016 and in force since 1 May 2017.

This Standard specifies the ordering requirements, manufacturing process, technical requirements, inspection rules and test methods, acceptance and quality certificates, marking and packaging of alloy structural steel forgings. This Standard applies to the ordering, manufacture and inspection of heavy alloy structural steel forgings for general purposes.

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) is applicable to this document.

GB/T 223 (all parts) Methods for Chemical Analysis of Iron, Steel and Alloy

GB/T 228.1 Metallic Materials - Tensile Testing - Part 1: Method of Test at Room Temperature (GB/T 228.1-2010, ISO 6892-1:2009, MOD)

GB/T 229 Metallic Materials - Charpy Pendulum Impact Test Method (GB/T 229-2007, ISO 148-1:2006, MOD)

GB/T 231.1 Metallic Materials - Brinell Hardness Test - Part 1: Test Method (GB/T 231.1-2009, ISO 6506-1:2005, MOD)

3 Ordering Requirements

3.1 The purchaser shall specify the name, grade, material designation, delivery status and supply quantity of the forgings in the ordering contract.

3.2 The purchaser shall provide the ordering drawing.

3.3 When the purchaser has supplementary requirements, it shall be agreed upon by both

parties.

4 Manufacturing Process

4.1 Smelting Steel for forgings shall be smelted by alkaline electric furnace. With the consent of the purchaser, other methods to ensure quality can also be used for smelting.

4.2 Forging Forgings shall be forged from ingots or billets. There shall be enough removal at both ends of the ingot to ensure that the forging body has no shrinkage cavity and serious segregation. Forgings shall be forged on forging equipment with sufficient capacity to ensure forging penetration and uniform structure. Forgings allow multiple length forging. Forgings shall be cooled slowly after forging to prevent cracking.

4.3 Heat treatment Forgings shall be cooled slowly by tempering at high temperature or normalizing and tempering or by other means to improve the structure and machinability. According to the material designation and strength grade of the forging, normalizing and tempering or quenching and tempering heat treatment process can be used. Forgings allow multiple length heat treatment.

4.4 Machining

4.4.1 The supplier may decide on a case-by-case basis whether or not to roughen all surfaces of the forging prior to the performance heat treatment.

4.4.2 The dimensions, tolerances and surface roughness of the delivered forgings shall comply with the provisions of the purchaser's ordering drawing.

4.5 Defect removal and repair welding

4.5.1 Local defects of forgings can be removed, but the removal depth shall not exceed 75% of the machining allowance.

4.5.2 For defective forgings, only after the welding evaluation results meet the mechanical properties of the same material designation and obtaining the purchaser's approval, can be repaired by repair welding.

5.1 Chemical composition

5.1.1 The supplier shall carry out smelting analysis for each furnace (each package) of molten steel, and the analysis results shall comply with the provisions of Table 1. The weighted average analysis results shall be reported when multiple furnaces are combined. from the extended part (extended section or enlarged section) or the remainder of the forging.

6.2.2.2 The sampling direction shall meet the following requirements:

a) For shaft, square or rectangular forgings, the direction of tensile and impact specimens

shall be the axial (longitudinal) direction;

b) For hollow cylinders, discs and annular forgings, the direction of the tensile and impact specimens shall be tangential (circumferential direction).

6.2.2.3 When the sampling location is not specified in the order drawing, the sampling can be carried out according to the following conditions:

a) The samples of solid shaft forgings are taken from one-third of the radius from the surface; and the samples of square and rectangular forgings are taken from one-third of the diagonal vertex to the center (see Figure 1);

b) The samples of hollow cylinder forgings are taken from half the wall thickness (see Figure 2);

c) For disc forgings, when sampling at the enlarged part of the outer diameter, the sample shall be taken from the half height of the enlarged part; when sampling at the extended part, the sample shall be taken from one third of the radius from the outer edge at or at least 20mm from the edge (see Figure 3);

d) For annular forgings, when sampling at the enlarged part of the outer diameter, the sample shall be taken from the half height of the enlarged part; when sampling at the extended part, the sample shall be taken from the half of the wall thickness (see Figure 4).

a) When the V-notch impact test is carried out, if the test results of a group of impact samples are unqualified, another group of three specimens can be taken from the adjacent parts of the original specimen for retesting, and the arithmetic mean of the two groups of samples before and after shall be no lower than the specified requirements; and the number of single values lower than the specified value shall be no more than two, and only one single value is allowed to be lower than 70% of the specified value;

b) When the U-notch impact test is carried out, if a test result is unqualified, double samples can be taken from the adjacent parts of the original sample for retesting, and the retest results of both samples shall meet the requirements.

6.4.3 If the mechanical property test fails due to white spots and cracks in the sample, it shall not be retested.

6.5 Reheat treatment When any mechanical property test result of the forging is still unqualified, re-heat treatment can be carried out, and re-sampling test can be carried out. The number of re-heat treatment shall be no more than twice, and the number of tempering shall be unlimited.

7 Acceptance and Quality Certificate

7.1 The purchaser has the right to select certain test items of the forgings for acceptance. During the acceptance inspection or subsequent processing or inspection, the purchaser