

ICS 77.140.85

CCS J 32



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

GB/T 33083-2016

Heavy carbon structural steel forgings - Technical specification

大型碳素结构钢锻件 技术条件

Issued on: October 13, 2016

Implemented on: May 1, 2017

**Issued by: General Administration of Quality Supervision, Inspection and
Quarantine;
Standardization Administration of the PRC**

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1 Scope

China's national technical specification for heavy carbon structural steel forgings - the shafts, rotors, cylinders, discs and rings weighing tonnes apiece that go into turbines, presses, rolling mills and heavy machinery, and that cannot be replaced once installed without taking the machine apart. 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 carbon structural steel forgings for general use in mechanical products. It applies to the ordering, the manufacture and the inspection of heavy carbon structural steel forgings for general use.

What distinguishes a heavy forging from a piece of bar stock is that its properties are not uniform: the centre of a large section cools slowly, so the structure and the properties there differ from those at the surface, and the piece may carry segregation and unsoundness at its axis from the ingot it was made from. The standard is written around that fact. It prescribes the manufacturing route - the smelting, the forging with its reduction ratio, the heat treatment and the conditions under which repair welding is permitted - and then the technical requirements: the chemical composition, the mechanical properties by strength grade, the hardness and the non-destructive testing. The inspection clause carries figures showing exactly where the test specimens are to be taken from a solid forging, a hollow cylinder, a disc and a ring, which is the heart of the document, because on a heavy forging the answer depends on where you cut; and it sets the retest and the re-heat treatment that may be applied when a first result fails, together with the acceptance, the quality certificate and the marking. 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 certificate, marking and packaging, etc. of carbon structural steel forgings for general use in mechanical products. This Standard applies to the ordering, manufacture, and inspection of heavy carbon structural steel forgings for general use.

2 Normative references

The following documents are indispensable for the application of this document. For the dated references, only the editions with the dates indicated are applicable to this document. For the undated references, the latest edition (including all the amendments) are 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 forging name, material designation, number of standard adopted, level, corresponding technical requirements and inspection items, delivery state, quantity supplied, and other additional descriptions in the ordering contract.

3.2 The purchaser shall provide the ordering drawings or related finishing drawings.

3.3 When the purchaser has additional requirements, it shall be agreed upon by the supplier and the purchaser.

4 Manufacturing process

4.1 Smelting The steel for forgings shall be smelted by electric furnace or other smelting methods agreed by the user which guarantee the quality.

4.2 Forging

4.2.1 Forgings shall be forged with steel ingots or billets. When the forgings are directly forged by steel ingots, at both ends of the ingot nozzle and riser, there shall be sufficient removal, to ensure that the forgings have no shrinkage cavity and severe segregation.

4.2.2 Forgings shall be forged on forging equipment with sufficient capacity, to ensure forging penetration and uniformity of macrostructure. Forgings allow for multiple-length forging.

4.3 Heat treatment Forgings shall be slowly cooled by high-temperature tempering, normalizing plus tempering, or other methods, to improve macrostructure and machinability. According to the material designation and strength grade of the forging, normalizing, normalizing plus tempering, or quenching-tempering heat treatment process may be used. Forgings allow for multiple-length heat treatment.

4.4 Repair welding For defective forgings, after the welding evaluation results meet the mechanical properties of the same material designation and are approved by the purchaser, they may be repaired by repair-welding.

5.1 Chemical composition

5.1.1 The supplier shall conduct heat analysis for each furnace (per pack) of molten steel. The analysis results shall comply with Table 1. For multi-furnace pouring, REPORT the weighted average analysis result.

5.1.2 When the purchaser has special requirements, the supplier shall carry out

6.1 Chemical composition analysis

6.1.1 Analysis method Chemical composition analysis shall be carried out according to the method specified in GB/T 223 or other methods approved by the purchaser which can guarantee the analysis quality.

6.1.2 Heat analysis

6.1.2.1 Each furnace (pack) of molten steel shall, when pouring, be sampled to determine the chemical composition of the molten steel.

6.1.2.2 When heat analysis is not possible, the finished product analysis is allowed to replace the heat analysis. The analysis results shall meet the requirements of finished product analysis.

6.1.3 Finished product analysis The sample for finished product analysis may be taken from the forging body or its extension part; or it may be taken from a mechanical property sample.

6.2.1 Inspection items and sampling quantities

6.2.1.1 According to the different uses and requirements of the forgings, refer to Table 4, to select the level and inspection items.

6.3 Hardness inspection According to the method specified in GB/T 231.1, perform Brinell hardness inspection for forgings. For forgings accepted according to hardness, Brinell hardness shall meet the requirements of Table 3. For forgings not accepted according to hardness, the hardness value shall also be recorded in the quality certificate and reported to the user. When hardness is required, for the forging to be inspected, on a representative section, inspect three points.

6.4 Retest

6.4.1 If one of the results in the tests of mechanical properties is unqualified, a retest is allowed. The retest samples shall be taken from the adjacent parts of the original sample. Double quantities of samples shall be taken for retest. All the retest results shall meet the specified requirements.

6.4.2 If the mechanical properties test is unqualified due to white spots and cracks in the sample, it shall not be retested.

6.5 Re-heat treatment When the inspection result of any mechanical property of the forgings is still unqualified, re-heat treatment may be carried out; re-sampling shall be carried out for test. The number of re-heat treatments shall not exceed two at most. The number of tempering is not limited.

7 Acceptance and quality certificate

7.1 The purchaser has the right to select certain test items of the forgings for acceptance. In acceptance inspection or subsequent processing or inspection, if it is found that the forgings do not meet this Standard and the supplementary technical requirements specified in the ordering contract, the purchaser shall promptly notify the supplier; the two parties shall negotiate to resolve.

7.2 The supplier shall provide the quality certificate to the purchaser. The quality certificate shall include at least the following contents: