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

GB/T 37775-2019

Heavy steel open die forgings - General technical specification

大型钢质自由锻件 通用技术规范

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1 Scope

China's national general technical specification for heavy open die steel forgings. Open die forging is how the largest forged components are made: an ingot is heated and worked between flat or simply shaped dies under a press, being manipulated and turned between blows, so the shape emerges from the sequence of operations rather than from an impression. It is the only way to make a rotor shaft, a mill roll, a pressure vessel shell or a press column, because no closed die of that size could be made or filled. The properties depend almost entirely on the working: the forging must reduce the ingot enough to close its centreline porosity and break up the as-cast structure, and it must do so throughout the section rather than only near the surface - which is a matter of the reduction achieved per pass and of the die geometry. That is why the specification governs the process and the resulting structure rather than only the finished dimensions.

2 Normative references

The following documents are essential for the application of this document. For dated references, only the dated version applies to this article pieces. For undated references, the latest edition (including all amendments) applies to this document. Allowable deviation of finished chemical composition of GB/T 222 steel

GB/T 223 (all parts) Methods for chemical analysis of steel and alloys

GB/T 228.1 Tensile Test of Metallic Materials Part

GB/T 6394 Metal Average Grain Size Determination Method

GB/T 10561 Determination of Non-metallic Inclusion Content in Steel Standard Grading Chart Microscopic Inspection Method

GB/T 13298 Metal Microstructure Test Method

GB/T 13299 Microstructure evaluation method of steel

GB/T 20066 Sampling and sample preparation method of samples for determination of chemical composition of steel and iron

JB/T 8467 Ultrasonic testing of steel forgings NB/T 47008-2010 Carbon steel and alloy steel forgings for pressure equipment

3 Terms and Definitions

The terms and definitions defined in NB/T 47008-2010 and the following terms and definitions apply to this document. For ease of use, the list is repeated below Certain terms and definitions in NB/T 47008-2010.

3.1 Steel forgings forged by a free forging press of more than 10MN and a free forging hammer of more than 50kN.

3.2 Shaft forgings A solid forging whose cross-section is circular and whose axial length L is greater than its diameter D.

3.3 Shelforging of cylindrical forgings Axisymmetric hollow forgings whose axial length L is greater than their outer diameter D. [NB/T 47008-2010, Definition 3.1]

3.4 Ring forging ringforging Axisymmetric hollow forgings whose axial length L is less than or equal to their outer diameter D. [NB/T 47008-2010, Definition 3.2]

3.5 pie forging diskforging Axisymmetric solid forgings whose axial length L is less than or equal to their outer diameter D.

3.6 bar forging Forgings whose section is rectangular and whose length L is greater than that on both sides.

Note. Rewrite NB/T 47008-2010, definition 3.6.

3.7 Combined forging Combining two or more forgings into one forging and forging production as one forging.

3.8 main section mainsection Sections to determine mechanical properties.

3.9 equivalentsection equivalentsection A section that has the same mechanical properties as the main section and is approximately equal.

4 Order Requirements

4.1 The purchaser shall state in the order contract the standards and technical conditions to be implemented, the name of the forging, the material grade, the order drawing, the order quantity, the delivery status, inspection items and other additional requirements.

4.2 If the forgings are transferred from the manufacturer to the sub-supplier, the sub-supplier shall have corresponding production conditions and qualifications or be approved by the purchaser.

4.3 For special products, in order to verify whether the manufacturer has the ability to manufacture qualified products, you can refer to the requirements of Appendix A for evaluation, and use The purchaser shall specify in the order contract.

4.4 If specified in the order contract or standard, the manufacturer shall prepare a manufacturing outline before the start of manufacture and submit it to the purchaser for approval. on the purchaser After approval, no modifications may be made without the purchaser's permission. If there are deviations that do not conform to the manufacturing outline during the production process, the purchaser should be notified. Submit a deviation request and record. For the content of the manufacturing outline, please refer to A.3.5.

5 Manufacturing process

5.1 Smelting and pouring Steel for forgings shall be killed steel smelted by electric furnace or converter plus ladle refining furnace, or electroslag remelting can ensure the quality of steel ingots other smelting methods.

5.2 Forging

5.2.1 The riser and nozzle of the steel ingot should have enough cutout to ensure that the finished forging has no shrinkage cavity and serious composition segregation.

5.2.2 The forgings should be forged on a forging equipment with sufficient pressure to improve the original defects of the ingot, such as solidification defects, welding, clamping. In order to ensure the internal quality of forgings.

5.2.3 When forging with steel ingots, the forging ratio of the total drawing length of the

unupset forgings shall not be less than 3.0; the upsetting forgings shall be drawn continuously for a single time. The forging ratio should not be less than 2.0, and the total drawing length forging ratio should not be less than 2.5. When forging with forging material or rolling material, the total forging ratio of drawing length shall not be less than 1.3. The draw-length forging ratio of the large-section flange can be appropriately reduced, but it shall not be less than 1.7. If electroslag ingots are used, the forging ratio should be appropriately reduced. The total forging ratio is calculated according to the method specified in Appendix B.

5.2.4 The shape and size of forgings shall meet the requirements of forging drawings and process documents. The forging process should consider the uniformity of forging and prevent mixed crystal. Post-forging heat treatment should take into account the adverse effects of removing hydrogen and preparing the structure for final heat treatment.

5.2.5 When required by the manufacturer, the method of combined forging can be used.

5.3 Heat treatment

5.3.1 Forgings shall be heat treated in accordance with the requirements of the material standard. During the heat preservation process, the furnace temperature should be within the range of the specified temperature $\pm 15^{\circ}\text{C}$ inside. If necessary, an external thermocouple should be placed on the surface of the forging. In the case of comprehensive consideration of the workpiece wall thickness, shape structure, size and other factors, the external thermocouple should be placed at the expected maximum temperature and minimum temperature of the forging.

5.3.2 If the minimum tempering temperature needs to be specified, the purchaser shall specify it in the order contract.

5.3.3 Performance After heat treatment, if the forging needs to be calibrated, the preheating temperature for hot calibration should be 40°C – 60°C lower than the tempering temperature. After calibration, it should be The stress relief treatment is carried out at a temperature of 30°C to 50°C lower than the final tempering temperature.

5.3.4 For forgings with residual stress requirements, controlled and slow cooling methods should be used for cooling to ensure that the residual stress value is lower than Specify requirements.

5.4 Defect removal and repair welding

5.4.1 For the local defects whose size exceeds the tolerance range, they can be ground and removed after being approved by the purchaser, and the grinding edge shall be smooth. transition, but the cleaning depth should not exceed 75% of the machining allowance. After grinding and cleaning, magnetic particle inspection should be carried out on the grinding part according to the material standard. testing or penetration testing to