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Rolling Bearings - Parts Made from High-carbon Chromium Bearing Steels - Specifications for Heat Treatment

滚动轴承 高碳铬轴承钢零件热处理技术条件

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1 Scope

This Standard specifies the technical requirements and test methods for annealing, quenching and tempering of G8Cr15, GCr15, GCr15SiMn, GCr15SiMo, GCr18Mo steel rolling bearing rings and rolling elements (hereinafter referred to as bearing parts) in accordance with GB/T 18254.

This Standard is applicable to the heat treatment quality inspection of the above-mentioned steel bearing parts process and finished parts, and also to the heat treatment quality inspection of other high-carbon chromium steel bearing parts. For bearing parts with special requirements, perform according to the specifications of corresponding product drawings.

2 Normative references

The following documents are indispensable for the application of this document. For dated references, only the dated version applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

GB/T 230.1-2009, Metallic materials. Rockwell hardness test. Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)

GB/T 231.1, Metallic materials. Brinell hardness test. Part 1: Test method

GB/T 272-2017, Rolling bearings. Identification code

GB/T 1172, Conversion of hardness and strength for ferrous metal

GB/T 4340.1, Metallic materials. Vickers hardness test. Part 1: Test method

GB/T 6394, Determination of estimating the average grain size of metal

GB/T 17394, Metallic materials - Leeb hardness test

GB/T 24606, Rolling bearings. Non-destructive testing. Magnetic particle testing

JB/T 7361, Rolling bearings. Test method for hardness of parts

	hardness value and size of the tested parts. The test method is according to provisions of GB/T 230.1, GB/T 231.1, GB/T 4340.1, GB/T 17394 and JB/T 7361. The hardness value is converted according to the provisions of GB/T 1172. b) For steel balls with a nominal diameter not greater than 15.8750 mm and rollers with a nominal diameter not greater than 15 mm, the measured surface hardness shall be corrected according to the provisions of Table F.1 and Table F.2 of Appendix F. The hardness measurement of the spherical roller is performed on the end face
Microstructure	Use a metallographic microscope to test at a magnification of 500 or 1000 times: a) The spheroidized annealed structure is etched with a 2% nitric acid solution, and tested according to the size, number and shape of the carbide particles according to the first level diagram (see Figure 1); b) The microstructure after quenching and tempering is tested on the longitudinal section (the steel ball can be inspected on any surface; in case of controversy, it is subjected to the longitudinal section), and etched with 2% ~ 4% nitric acid solution; c) The martensite structure after quenching and tempering is tested according to the thickness of martensite, the size and quantity of residual carbide particles according to the second level diagram (see Figure 2). The microstructure can be inspected under quenching conditions, and in case of disagreement, it is tested in a tempered state; d) The troostite structure after quenching and tempering is tested according to the shape, size and quantity of troostite according to the third level diagram (see Figure 3). The acicular or massive troostite is tested according to the corresponding troostite level diagram. The acicular and massive mixed troostite is tested according to the form and type of troostite of the main part in the field of view; e) The bainite structure is tested according to the thickness of bainite, the size and quantity of residual carbide particles according to the fifth level diagram (see Figure 5).
Reticulated carbide	Use a metallographic microscope to test at a magnification of 500 times. The annealed sample is inspected on the cross section after normal quenching and tempering; use 4% nitric acid alcohol solution for deep etch according to the size and degree of sealing of the carbide net, according to the fourth level diagram (see Figure 4).
Decarburization depth and surface soft point	a) Surface decarburization and soft spots can be tested by cold pickling; the inspection procedures are shown in Appendix G; b) Decarburization depth is determined in accordance with JB/T 7362. When it is measured by the metallographic method, use 2% nitric acid alcohol solution to etch in the annealed state. For the hot steel

Appendix B

(Normative)

Steel ball crushing load test procedure and crushing load value after heat treatment

B.1 Scope

This appendix specifies the crushing load test procedure and crushing load value for steel balls whose nominal diameter is ϕ3 mm ~ ϕ50.8 mm.

B.2 Steel ball crushing load test procedure

B.2.1 For each batch of heat-treated steel balls, take three sets of balls (9 pieces) for the ball crushing load test. The dimensional tolerances of the steel balls shall be the same.

B.2.2 When the semi-finished steel ball after heat treatment is taken for the crushing test, the surface of the steel ball is not allowed to have surface defects such as wheel injury, pit, bump or pitting.

B.2.3 When the crushing test is carried out, the loading speed can be loaded as per 980 N/s ~ 5 880 N/s.

B.2.4 When the steel ball crushing test is carried out, if the load value that is applied to the steel ball has exceeded the standard, and the steel ball is not crushed, it can be unloaded; if there is special requirement, the steel ball can be loaded until it is crushed.

B.2.5 Remove the ball-pressing tire from the test machine; open the safety cover; quickly remove the steel ball and throw it into the iron box with a cover, so as to prevent the steel ball from breaking and injuring people; record the test results.

B.2.6 During the test, if the result is inaccurate due to improper placement of the steel ball or cracks in the steel ball, the result shall be invalid and the sample shall be re-tested.

B.2.7 During the test, if the crushing load of the steel ball has reached the specified standard, and the steel ball is broken during unloading, the result is treated as qualified.

B.2.8 During the test, the loading speed must not be changed abruptly or unloaded midway.

Appendix G

(Normative)

Pickling inspection procedure

G.1 Cold pickling

Cold pickling is applicable to the inspection of defects such as soft spots, decarburization on the surface and cracks on the part surface of the bearing parts after quenching and tempering. Parts shall be sandblasted and degreased before pickling, so as to remove surface scale and oil; perform the cold pickling at room temperature.

G.1.1 Cold pickling procedure

G.1.1.1 Pickling treatment

Place the bearing parts in a 6% ~ 30% (by volume) aqueous solution of nitric acid pickling tank; the pickling time is about 1 min; then, rinse it in a flowing cold-water bath for 1 min ~ 2 min.

The concentration of nitric acid (mass fraction: 65% ~ 68%) in the pickling tank is for reference only; it can be adjusted according to the surface darkness and size consumption of the parts after pickling. When the surface of the pickling parts is decarburized, the concentration of nitric acid can be 6%.

G.1.1.2 First clearing treatment

In the first clearing tank, perform clearing treatment for the parts after pickling for 10 s ~ 20 s; then, rinse it in a flowing cold-water tank for 1 min ~ 2 min. The distribution ratio of the clearing tank solution can be any one of Table G.1.

Table G.1 -- Distribution ratio of the clearing tank solution

Chemical composition	Category	
	1	2
	Volume ratio	
Phosphoric acid [a]	-	10% ~ 15%
Sodium hydroxide	3% ~ 5%	-
Potassium permanganate	3% ~ 5%	3% ~ 5%
Trisodium phosphate	6% ~ 9%	-
Water	Allowance	Allowance
Note: When the solution is prepared, add water, then add acid, so as to avoid splashing.		
[a] The mass fraction of phosphoric acid shall be ≥ 85%.		

a) qualified surface: the surface is uniform and dark gray;

b) soft surface: the surface is cloud-like dark black spots, and the perimeter is incomplete;

c) decarburization: the surface is grayish white or dark black spots;

d) crack: the surface is dark black and thin stripe.

G.2 Hot pickling

G.2.1 Hot pickling is applicable to the inspection of surface cracks of bearing parts after quenching and tempering. Parts shall be sandblasted and degreased before pickling, so as to remove surface scale and oil.

G.2.2 Before the hot pickling, the bearing parts shall be destressed and tempered. The tempering temperature shall be greater than 350°C and the tempering time shall be 2 h ~ 3 h.

G.2.3 Place the bearing parts in 50% hydrochloric acid aqueous solution; heat the solution to 60°C ± 5°C; the pickling time is 10 min ~ 30 min; then, rinse in flowing cold water for 1 min ~ 2 min.

G.2.4 Dry the hot-pickled parts and place them under an astigmatism lamp to visually inspect the cracks.

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