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PEOPLE'S REPUBLIC OF CHINA**

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**Metallographic examination for the carburizing, quenching and
tempering of steel parts**

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Foreword

Appendix B, Appendix C, Appendix E, Appendix G of this standard are normative annexes. Appendix A, Appendix D, Appendix F are informative annexes. This standard was proposed AND shall be under the jurisdiction of the National Heat Treatment Standardization Technical Committee (SAC/TC 75). Drafting organizations of this standard. Shanghai Machinery Manufacturing Technology Research Institute Co., Ltd., Guangdong Shichuang Metal Technology Co., Ltd. The main drafters of this standard. Chen Dehua, Yu Hui, Ren Songzan, Ye Jian, Dong Xiaohong, Ma Chunxia, Su Yuhui, Ha Shengnan. Metallographic examination for carburizing quenching and tempering of steel parts

1 Scope

China's national method for the metallographic examination of carburized, quenched and tempered steel parts. It specifies the specimens, the preparation, the examination and the rating of the microstructure produced by case hardening. Carburizing is how a gear, a shaft, a bearing race or a camshaft is given a hard wear-resistant surface over a tough core. The part is made from a low-carbon steel, held at temperature in a carbon-rich atmosphere so that carbon diffuses into the surface, then quenched - and the high-carbon case transforms to hard martensite while the low-carbon core stays tough. The result is a component that

resists surface fatigue and wear without being brittle, and it is the standard treatment for the most heavily loaded parts in a gearbox or an engine. What determines whether it worked cannot be measured by hardness alone. The microstructure carries the evidence: the martensite and its coarseness, which reflects the austenitising temperature; the retained austenite, which is soft, dimensionally unstable and transforms in service; the carbides and whether they are dispersed or formed a network at the grain boundaries, which embrittles the case; the internal oxidation at the surface, which occurs in gas carburizing and creates a soft non-martensitic layer exactly where the stress is highest; and the core structure. Each of those is a separate rating with its own reference series, and each is a different process fault. So the standard sets out the sampling and the sectioning, the preparation and etching, the magnification, and the rating scales with their limits - and it is what a heat treatment specification refers to when it states what the finished case must be. Issued on 23 December 2010 and in force since 1 June 2011.

This standard specifies the method for the inspection of the carburizing quenching and tempering metallographic structure of steel parts, the level of the metallographic structure, the determination of the effective depth of hardened layer of the carburizing quenching. This standard is applicable to workpieces, whose effective hardened layer depth is greater than 0.3 mm by carburizing quenching.

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard; however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 7232 Terminology of metal heat treatment

GB/T 9450 Steels - Determination and verification of the depth of carburized and hardened cases (GB/T 9450-2005, ISO 2639.2002, MOD)

GB/T 13298 Metal - Inspection method of microstructure

3 Terms and definitions

The terms and definitions as defined in GB/T 7232, as well as the following terms and definitions, apply to this standard.

3.1 Core structure The structure in the area, which is 3 times the depth of the effective hardened layer of carburizing quenching from the surface.

4 Specimen

4.1 From the workpiece, take specimen in a representative service area, OR take a furnace specimen of the corresponding size. The surface roughness of the furnace specimen shall be the same as that of the workpiece.

4.3 The test surface shall be perpendicular to the surface of the carburized layer.

4.4 For specimens with special requirements, it shall be determined, through negotiation, between the supplier and the buyer. Regarding the requirements for tooth profile specimens, see Appendix A.

5 Inspection items and inspection methods

5.1 The inspection items and inspection methods are as shown in Table 1.

5.2 For the metallographic test, it shall prepare specimens according to GB/T 13298. The etchant is 4% nitric acid alcohol solution.

5.3 For the inspection and rating of metallographic structure, it shall be evaluated at the highest level. If it exceeds the highest level, it can be expressed as greater than level 6.

6 Rating of metallographic structure level

6.1 Levels of martensite According to the rated level of the size of the martensite needle body, carry out the rating, in comparison with the series of ratings in Figure B.1 in Appendix B. The rating's description is as shown in Table 2.

6.2 Level of retained austenite According to the rating level of the retained austenite content, refer to Figure

6.3 Levels of carbide According to the rating of the carbide form, quantity, size, distribution, carry out the rating, in comparison with the series of ratings in Figure E.1 in Appendix E. The description of rating is as shown in Table 4.

6.5 Levels of Core structure According to the rated level of morphology of the core structure, the size, shape and quantity of ferrite, carry out the rating according to the series of images in Figure G.1 of Appendix G. The description of rating is as shown in Table 6.

7 Inspection equipment

7.1 The Vickers hardness tester and the standard block shall pass the calibration. It shall be used within the calibration period.

8 Inspection report

The inspection report shall generally include the following.

Appendix A

(Informative) General requirements for the metallographic inspection of steel gears by carburizing quenching and tempering A.1 Specimen A.1.1 For the tooth-shaped workpiece, cut at least one complete tooth profile. It may also use cylindrical specimens OR simulated tooth thickness specimens. Cylindrical specimen's size. the minimum diameter is 6 times the modulus, BUT not less than 16 mm A.1.2 The test surface of the tooth profile specimen shall be on the normal section of the tooth. A.1.3 Except for the above description, all others shall be implemented, in accordance with Chapter 4 of the main text of this standard. A.2 Inspection items and inspection methods A.2.1 The measuring position of the effective hardened layer depth of the gear is generally on the normal section of the tooth width, in the direction along the vertical tooth surface at the index circle, OR according to the specific process documents. A.2.2 The inspection positions of the martensite and retained austenite are within

0.05 mm ~

0.15 mm, from the surface of the carburized layer at the index circle of the tooth. A.3 Except for the above two provisions, all others shall be implemented in accordance with the text of this standard. Figure A.1 -- Schematic diagram of the inspection position of the core structure of large gear

Appendix B

(Normative) Martensite level chart The martensite level chart (500x) is as shown in Figure B.1.

Appendix C

(Normative) Retained austenite level chart (500x) The retained austenite level chart (500x) is as shown in Figure C.1.

Appendix D

(Informative) Retained austenite level chart (1000x) The retained austenite level chart (1000x) is as shown in Figure D.1.

Appendix E

(Normative) Carbide level chart The network and granular carbide level chart (500x) is as shown in Figure E.1.