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General rules of hardness test for heat treated parts

热处理件硬度检验通则

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Foreword

This standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This standard was proposed by, and is under the administration of, the National Technical Committee on Heat Treatment of Standardization Administration of China (SAC/TC 75).

The drafting organisations of this standard are Jiangsu Fengdong Heat Treatment and Surface Modification Engineering Technology Research Co., Ltd., Beijing Research Institute of Mechanical and Electrical Technology Co., Ltd., Tianjin Heat Treatment Research

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1 Scope

China's national general rules for the hardness testing of heat treated parts. Hardness is the most used mechanical measurement in industry because it is quick, cheap and very nearly non-destructive, and it is also the measurement most often made in a way that produces a meaningless number. The choice of method is the first trap: Rockwell, Brinell, Vickers, Leeb, Shore and Knoop measure at different loads and different depths, and a case hardened part read on a Brinell scale returns the hardness of the core, because the indenter goes straight through the case. The specimen is the second: a surface carrying scale, decarburisation or a cracked layer, or one too thin for the indentation being made, gives a reading that belongs to the flaw and not to the metal. Where the reading is taken is the third, since hardness varies from one part of a component to another and a figure from a corner says nothing about the whole. This standard exists so that a hardness figure means the same thing in the supplier's laboratory and in the customer's inspection department. It sets out the principles for choosing the test method according to the material, the heat treatment process and the hardness range expected, the requirements on the specimen and on how it is prepared and sampled, the environment the test is carried out in, the training and supervision of the people who carry it out, the management of the testing machine and of the reference blocks including their verification intervals, the conduct of the test and the choice of the place to be tested, the way the result is expressed, the inspection report, and the evaluation of the uncertainty. Its normative annexes go further, giving the minimum thickness the specimen must have for each method and the correction values to be applied when the surface tested is curved rather than flat.

This standard specifies the principles for selecting a hardness test method for heat treated parts, the specimen to be tested, the inspection environment, the requirements on personnel, the management of the instruments, the hardness test itself, the inspection result and the expression of the hardness value, the inspection report and its issue, and the evaluation of the uncertainty.

This standard applies to the hardness inspection of heat treated metallic materials. It may also be used as a reference when a portable hardness tester is employed.

2 Normative references

The following documents are indispensable for the application of this document. For dated

references, only the edition cited applies. For undated references, the latest edition of the referenced document, including all amendments, applies.

GB/T 230.1, GB/T 230.2 and GB/T 230.3 Metallic materials - Rockwell hardness test, parts 1 to 3: test method, verification and calibration of the testing machines for the A, B, C, D, E, F, G, H, K, N and T scales, and calibration of the reference blocks for those scales.

GB/T 231.1, GB/T 231.2 and GB/T 231.3 Metallic materials - Brinell hardness test, parts 1 to 3: test method, verification and calibration of the testing machines, and calibration of the reference blocks.

GB/T 1172 Conversion of hardness and strength values for ferrous metals.

GB/T 4340.1, GB/T 4340.2 and GB/T 4340.3 Metallic materials - Vickers hardness test, parts 1 to 3.

GB/T 4341.1, GB/T 4341.2 and GB/T 4341.3 Metallic materials - Shore hardness test, parts 1 to 3.

GB/T 7232 Terminology of metal heat treatment; GB/T 8170 Rules of rounding off for numerical values and expression and judgement of limiting values; GB/T 13313 Shore and Leeb hardness test methods for rolling mill rolls.

GB/T 17394.1, GB/T 17394.2 and GB/T 17394.3 Metallic materials - Leeb hardness test, parts 1 to 3.

GB/T 18449.1, GB/T 18449.2 and GB/T 18449.3 Metallic materials - Knoop hardness test, parts 1 to 3.

GB/T 33362 Metallic materials - Conversion of hardness values.

3 Terms and definitions

The terms and definitions given in GB/T 7232 and the following apply to this document.

3.1 hardness: the degree to which a solid is hard, that is the ability of a mineral or a material to resist being scratched by, or having another body pressed into, its surface.

3.2 test: an activity carried out on one or more characteristics of an entity, such as measuring, examining, testing or gauging, and comparing the result with the specified requirements, in order to determine whether each characteristic conforms.

3.3 calibration: an operation which, under specified conditions, first establishes the relation between the quantity values provided by a measurement standard and the corresponding indications, and then establishes the relation by which a measurement result is obtained from an indication. Note: both the quantity values provided by the measurement standard and the corresponding indications carry a measurement uncertainty.

3.4 verification: an activity that ascertains and confirms that a measuring instrument

conforms to the statutory requirements. Note: verification includes examination, marking and the issue of a verification certificate, or either of those.

4 Principles for selecting the hardness test method

4.1 According to the principle of the test, the hardness test methods are divided into Rockwell, Brinell, Vickers, Leeb, Shore, Knoop and others; the field of application of each method is given in Table A.1 of Annex A.

4.2 The general test method may be chosen according to the material of the workpiece and to whether its hardness is high or low. The hardness ranges of commonly used heat treated parts, and the corresponding test methods, are given in Table 1.

4.3 The hardness test methods for parts after the various heat treatment processes, and the principles for choosing between them, are given in Table 2.

4.4 Once the test method has been chosen, the larger test force shall be used if the hardness range, the thickness and the size of the specimen permit it.

4.5 For metal workpieces whose hardness value is below 450 HBW, the Brinell method should be chosen.

Table 1 gives, for each material and heat treatment process, the hardness range obtained and the test method to be used. For high quality carbon structural steel: hot rolled, 131 HBW to 302 HBW; annealed, 140 HBW to 255 HBW; isothermally normalised, 150 HBW to 180 HBW; all tested by the Brinell method to GB/T 231.1. For alloy structural steel, annealed, 140 HBW to 269 HBW, Brinell method to GB/T 231.1. For carbon tool steel: annealed, 140 HBW to 217 HBW by the Brinell method; after quenching, not less than 62 HRC by the Rockwell method to GB/T 230.1. For alloy tool steel: as delivered by the steelworks, 140 HBW to 268 HBW by the Brinell method; quenched, from not less than 45 HRC to 64 HRC by the Rockwell method. For high speed tool steel: as delivered by the steelworks, not more than 285 HBW by the Brinell method; quenched and tempered, from not less than 63 HRC to 66 HRC by the Rockwell method. For bearing steel: annealed, 170 HBW to 207 HBW by the Brinell method; quenched and tempered, 58 HRC to 66 HRC by the Rockwell method.

Table 2 sets out, for each heat treatment process, the hardness test method and the standard to be applied together with the principle governing the choice. For parts with a non-metallic diffusion layer other than those already listed, the Vickers method of GB/T 4340.1, the Rockwell method of GB/T 230.1 and the Leeb method of GB/T 17394.1 are given, the surface hardness being tested as a rule by the Vickers method of GB/T 4340.1 and the hardness of the base material by the Rockwell method of GB/T 230.1, while for large workpieces the Leeb method of GB/T 17394.1 may be used.