

EDS

Engineering,
GM DAEWOO Auto & Technology
Standards

METHOD OF AUSTENITE GRAIN SIZE MEASUREMENT ARBONITRIDED FOR STEEL

EDS-T-7107

ISSUED DATE: 1993. 07. 13

REVISED DATE: 2006. 06. 19

VERSION: 3

1. PURPOSE

This standard aims at measuring grain size which influences mechanical property of steel.

2. SCOPE

This standard specifies the testing method of measuring austenite grain size(hereinafter referred to as the grain size) of carbon steels for machine structure use, low alloy steel, H-steel.

3. DEFINITIONS

3.1. Grain size: The term "grain size" shall mean the size of austenite grain establishing by the alloying elements, the heating temperature and the holding time when steel has been heated to a temperature above its transformation point(A_{c3} , A_{c1} , or A_{cm}) or to a temperature for the purpose of annealing, normalizing, quenching, carburizing or other heat treatment, and shall be expressed in grain size number.

4. NUMBER OF TEST PIECES

For initial sample approval purposes, at least 3 test pieces shall be tested and for routine quality control, technical examination and analysis of failure (including analysis of claim cause), at least 1 test piece shall be tested

5. TEST METHOD

5.1. McQuaid - Ehn method(carburizing method)

Method of measuring grain size by annealing steel at high temperature and for long time. A kind of testing method of carburized grain size.

5.1.1. Test piece

The test piece shall be, as a rule, circular or square in shape, 5 to 20mm in diameter or width, and 10 to 30mm in length, with any rust, decarburized layer, carburized layer, oil, grease, or other deposit removed.

5.1.2. Testing method

- (1) The test piece shall be embedded and sealed in a container filled with carburizing solution(80% OPEL M113 + 20% $BACO_3$), placed and heated in an electric furnace or other appropriate heating furnace in such a manner that the temperature is raised to $930^{\circ}C$ for $3\frac{1}{2}$ hours, and maintained at this temperature for 8 hours. After furnace cooling at $550^{\circ}C$ for $3\frac{1}{2}$ hours, the test piece shall be taken out from furnace and air-cooled.
- (2) The test piece shall be cut as close along the centre-line as possible.
- (3) The cut plane shall be finished by polishing, and etched with a 5% Nital solution, and the grain size shall be measured under a microscope at an area where hypereutectoid cementite has precipitated as a network. At this time, surface & sub-surface, specially the area of small grain boundary, shall not be evaluated.

5.2. Quenching method

Method of measuring grain size by quenching steel.

5.2.1. Test piece

The test piece, circular or square in shape, 10 to 15mm in diameter or width and 10 to 15mm in length.

5.2.2. Testing method

- (1) The test piece shall be maintained at the required quenching temperature for the required period, and quenched completely in a satisfactory manner. (In general, it shall be heated at 880℃ for 4 hours, and water-cooled).
- (2) The surface of the test piece shall be finished by polishing, and etched in an etching reagent, heated to 80℃, consisted of 100cc of distilled water, 10g of picric acid, 8mg of CuCl₂ and 20mg of surface active agent, the grain size shall be measured under a microscope.

6. EVALUATION

6.1. The grain size measured under a microscope shall be compared with the reference size for determination of the corresponding grain size number. In this case, as a standard practice, the microscope shall be of 100 magnifications, the shape and size of the projected image or the photographic print shall be a circle 80mm in diameter.

6.2. The grain size number shall be rounded off to integral number.

6.3. When it is difficult to make the determination at 100 magnifications, the compensated value calculated by the following formula shall be added to the grain size of that case of an appropriate magnification in comparison with the standard grain size.

$$N_{100} = N_M + Q$$

$$Q = 6.64 \log M/100$$

Where, N_{100} : Grain size number at 100 magnifications

N_M : Grain size number at M magnifications

Q : Compensated value

M : Magnification

In this case, at 50 magnifications, the grain size number obtained shall be decreased by 2, and at 200 magnifications, the grain size obtained shall be increased by 2.

6.4. The number of visual fields shall numbers, as a rule, 5 to 10.

6.5. The mean grain size number shall be calculated by the following formula.

$$m = \frac{\sum a \cdot b}{\sum b}$$

Where, m = Mean grain size number

a = Grain size number in each visual field

b = Number of visual field

7. REFERENCE

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| OPEL 202 | Determination of austenite grain size |
| JIS G 0551 | Method of Austenite Grain Size Test for Steel. |