

EDS

Engineering,
GM DAEWOO Auto & Technology
Standards

METHOD OF FERRITE GRAIN SIZE MEASUREMENT FOR STEEL

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1. PURPOSE

This standard aims at measuring ferrite crystal grain size(hereinafter referred to as grain size) as a part of measures to examine mechanical properties, for mechanical properties of steels generally vary according to the crystal grain size of steel.

2. SCOPE

This standard mainly specifies the method of measuring grain size of steel with a carbon content of 0.2 weight percent max.

3. DEFINITION

3.1. Grain size

Grain size shall be the size of ferrite crystal grain of steel, 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. Preparation of 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.

5.2. Testing method

Steel section, as a test piece, parallel to or at a right angle to the working direction shall be etched after being finished by polishing. For this etching, a solution, preferably of 5 percent Nital should be applied for 10~15 seconds. However, if necessary, the surface, as it is, of the test piece may be subjected to the testing.

6. EVALUATION

The comparison method shall be used in principle. However, when accuracy must be ensured or when the ferrite crystal grain is severely elongated, the intercept method or the mean area method is recommended.

6.1. Comparison method

6.1.1. The grain size measured under a microscope shall be compared with the standard drawings to determine a corresponding grain size number. As a rule, the microscope in this case shall have a magnification of 100X. For the micro photographic print or the size of the projected image, a circle of 80mm diameter shall be the standard. The number of visual fields shall be 10 min. and the mean grain size shall be calculated by the following formula. The

grain size number shall be rounded off to integral number.

$$m = \frac{\sum(a \times b)}{\sum b} \text{ Where } m: \text{ Mean grain size number}$$

a : Grain size number in each visual field
 b : Number of visual fields indicating the identical grain size number

6.1.2. In case crystal grain of different grain size number by about 3 is mixed within visual field, the proportion of the areas of each grain size number shall be determined by naked eye.

6.1.3. In case pearlite and cementite etc. are mixed in great numbers, determination of a corresponding grain size number for only ferrite crystal grain shall be made by comparison with the standard drawing.

6.1.4. At 50 magnification, the grain size number thus obtained shall be decreased by 2 and at 200 magnification, the grain size number shall be increased by 2.

6.2. Intercept method

6.2.1. The number of the crystal grain intercepted by the 2 segments of a fixed length orthogonally crossing each other shall be determined by observing the grains appearing on the etched plane under a microscope or by means of a microphotograph.

In this case, grain size number shall be calculated by the following formula and rounded off to integral number.

$$n = 500 \times \frac{M}{100} \times \frac{I_1 \times I_2}{L_1 \times L_2} \qquad N = \frac{\log n}{0.301} + 1$$

Where n : Number of grain size in 25 mm² under a microscope of 100 magnification

N : Grain size number

M : Microscope magnification

L_1, L_2 : Total length(in mm) of one linear length of the segments orthogonally crossing each other

I_1, I_2 : Total number of crystal grain intercepted by L_1 (or L_2)

6.2.2. The ferrite crystal grain partially intercepted at both ends of a segment shall be counted only one grain and in case there is one partially intercepted grain at one end of a segment, no count shall be taken. Also, the magnification of the microscope shall be so adjusted that the number of ferrite crystal grain to be intercepted by one segment will be 10 min. within one visual field and the measurement shall be continued for several visual fields until those grains amount to 50 min.

6.3. Mean area method

6.3.1. Measure the number of crystal grains in a circle or square of a certain size by observing the grains appearing on the etched plane under a microscope or by means of a microphotograph. In this case, the