

KES

Determination of Ferrite Grain Size

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1. Scope of application

This standard principally shall prescribe the test method measuring ferrite crystallized grain size (It is written as grain size hereafter) of carbon steel containing carbon under 0.2 % .

2. Purpose

This purpose of the test shall be to obtain reproducible test results with standardizing ferrite crystallized grain size of steel that influences mechanical characteristics.

3. Equipment for test

- (1) Measure it with PME optical microscope KIA possesses.
- (2) Obtain the section that is crossing at right angles to processing direction or is in parallel with processing direction, then corrode it after grinding it. However, surface of steel can be testing surface if necessary.

4. Testing method

There are three testing methods as following table 1.

Table 1

Testing method	symbol
Comparison method	FGC
Cutting off method	FGI
Area integration method	FGP

As testing method, a fundamental rule is to apply Comparison method to test. But especially, in case that it is a need of precision, crystallized grain of ferrite and commentate is severely wide spread, it is the better for following cutting off method or area

integration method

(1) Comparison method

Measuring the grain size appeared in corrosive surface by microscope, compare it with standard drawing(Additional drawing 1). Standard drawing is determined by the grain size according to table 2 with measuring it of 100 magnifications by microscope.

Table 2

Grain size N	Number of crystallized grain In 25.4 mm at 100 magnification		Number of crystallized grain In area 1 mm ² (n)	Number of crystallized grain In 1 mm ²	Average area of crystallized grain (mm ²)
	Average	Scope			
00	1 / 4	3 / 16 ~ 3 / 8	4	5.7	0.25
0	1 / 2	3 / 8 ~ 3 / 4	8	16	0.125
1	1	3 / 4 ~ 1 1 / 2	16	45	0.062
2	2	~	32	128	0.031
3	4	3 ~ 6	64	360	0.0156
4	8	6 ~ 12	128	1020	0.0078
5	16	12 ~ 24	256	2900	0.0039
6	32	24 ~ 48	512	8200	0.00195
7	64	48 ~ 96	1024	23000	0.00098
8	128	96 ~ 192	2048	56000	0.00049
9	256	192 ~ 384	4096	185000	0.000244
10	512	384 ~ 768	8192	520000	0.000122

(2) Cutting off method

With photographing or measuring a corrosive surface by a microscope, measure the number of crystallized grains cut by perpendicularly crossing two lines of fixed length. In this case, however grain size No. is obtained according to the following formula, round it off at second under a decimal point.

$$n_M = 0.8 \times \left(\frac{I_1 \times I_2}{L_1 \times L_2} \right)$$

$$n = n_M \times M^2$$

$$N = \frac{\log n}{0.301} - 3 \dots\dots\dots (1) \quad (\text{Refer to the attached table 3})$$

Where n_M : Number of crystallized grain in 1 mm² at M magnifications

n : Number of crystallized grain in net area 1 mm²

N : Grain size No.

M : Magnification of microscope

L_1, L_2 : Length of perpendicularly crossing lines(mm)

I_1, I_2 : Number of crystallized grains cut by L_1 (or L_2)

Include crystallized grain of cutting partly only one side at both side of a line, and do not include crystallized grain of not cutting only one side.

Select the magnification of a microscope that can measure the number of crystallized grains cut by one line, measure it over total 50 magnifications.

(3) Area integration method

With photographing or measuring a corrosive surface by a microscope, measure the number of crystallized grains contained in circle or tetragon. In this case, the magnification of microscope is 100, reflective image of a microscope view or size of microscope photograph should be 5000 mm²(In case of a circle, 80 mm diameter).

Calculation of number of crystallized grains is adding half of number of crystallized grains that intersect a boundary line to the number of crystallized grains completely in a boundary line. In this case, grain size No. is obtained according to the following formula, round it off at second under a decimal point.

$$X = \frac{W}{2} + Z$$

$$n = X \times \frac{M^2}{5000}$$

$$N = \frac{\log n}{0.301} - 3 \dots\dots\dots (1) \quad \text{(Refer to the attached table 3)}$$

- Where W : Number of crystallized grain on a boundary line
- Z : Number of crystallized grain completely in a boundary line
- X : Number of crystallized grain in 5000 mm²
- M : Magnification of microscope
- n : Number of crystallized grain in a net area 1 mm²
- N : Grain size No.

An example : It is the sample to measure Grain size No. by Area integration method as follows

$$W = 22$$

$$Z = 21$$

$$X = \frac{22}{2} + 21 = 32$$

$$n = 32 \times \frac{100^2}{5000} = 64 \quad N = \frac{\log 64}{0.301} - 3 = \frac{1.806}{0.301} - 3 = 3$$

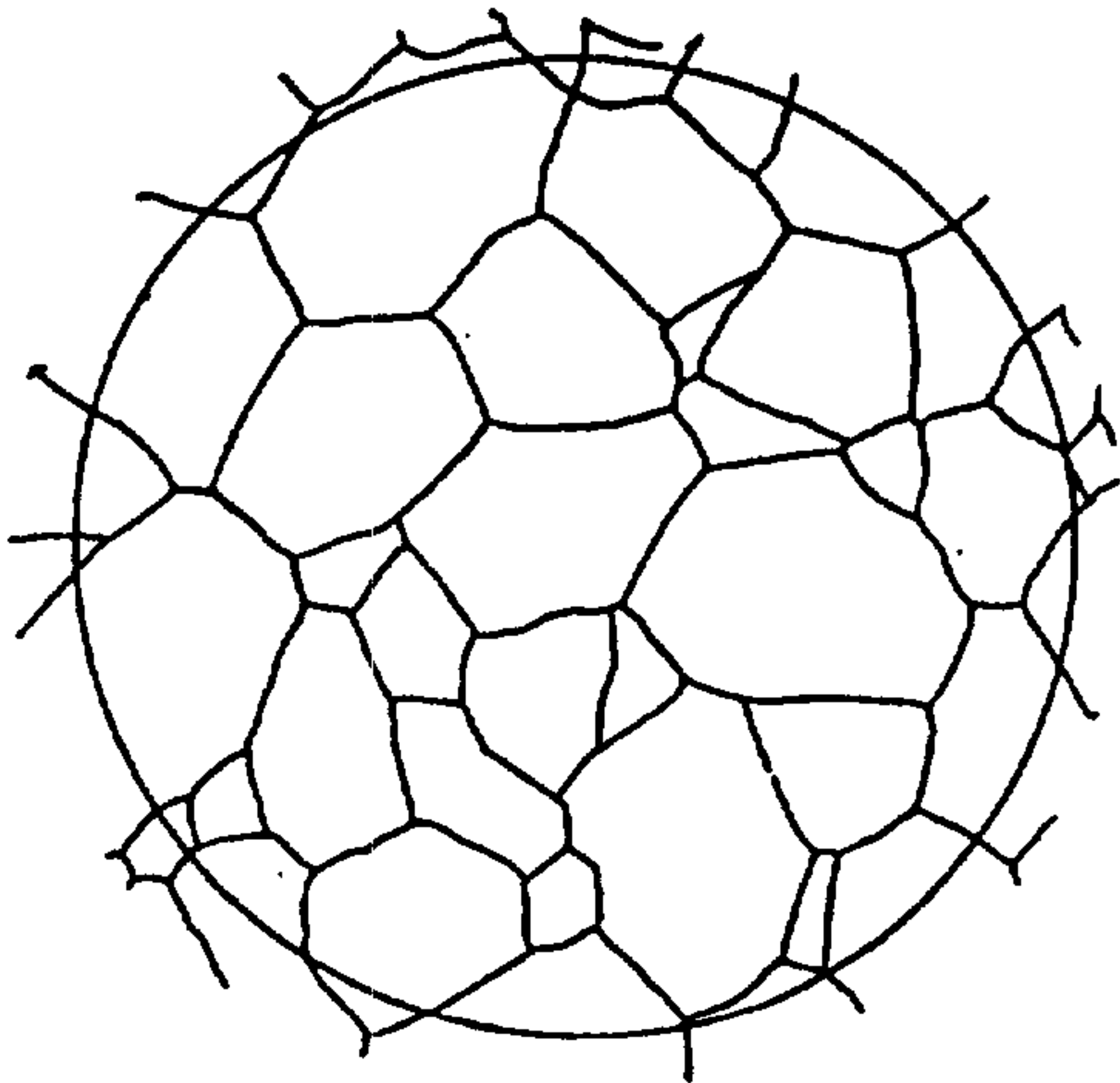


Figure 1. Grain size No.3(100 Magnifications)