

EDS

Engineering,
GM DAEWOO Auto & Technology.
Standards

EVALUATION OF NON-METALLIC INCLUSION IN STEEL

EDS-T-7105

ISSUED DATE: 1988. 11. 10

REVISED DATE: 2004. 12. 21

VERSION: 4

1. PURPOSE AND SCOPE

This standard specifies the microscopic evaluation method for non-metallic inclusions in steels with the help of figure diagrams and tables.

Non-metallic inclusions shall be tested according to method M and method K.

2. CONCEPTION

Non-metallic inclusions may cause structure destruction in steels and affect steel properties and its form and distribution depend on melting method of steels, construction of furnace, kind and method of deoxidation and machining method.

Distributions and form of inclusions, besides the quality of steels, may be learned with the average determination method according to method M and evaluation method according to method K.

3. TEST SAMPLE

3.1. Form of test sample

3.1.1. Sampling area of test pieces to be tested for each test sample (refer to Fig. 1).

Dimensions (diameter or lateral length)	Position of slide-surface in the test sample
25mm max.	Over the entire cross section(cross section including center axis)
25 ~ 50mm	Over the entire cross section or cross section from the edge to longitudinal axis
50mm min.	In the center between edge and longitudinal axis or according to the agreement

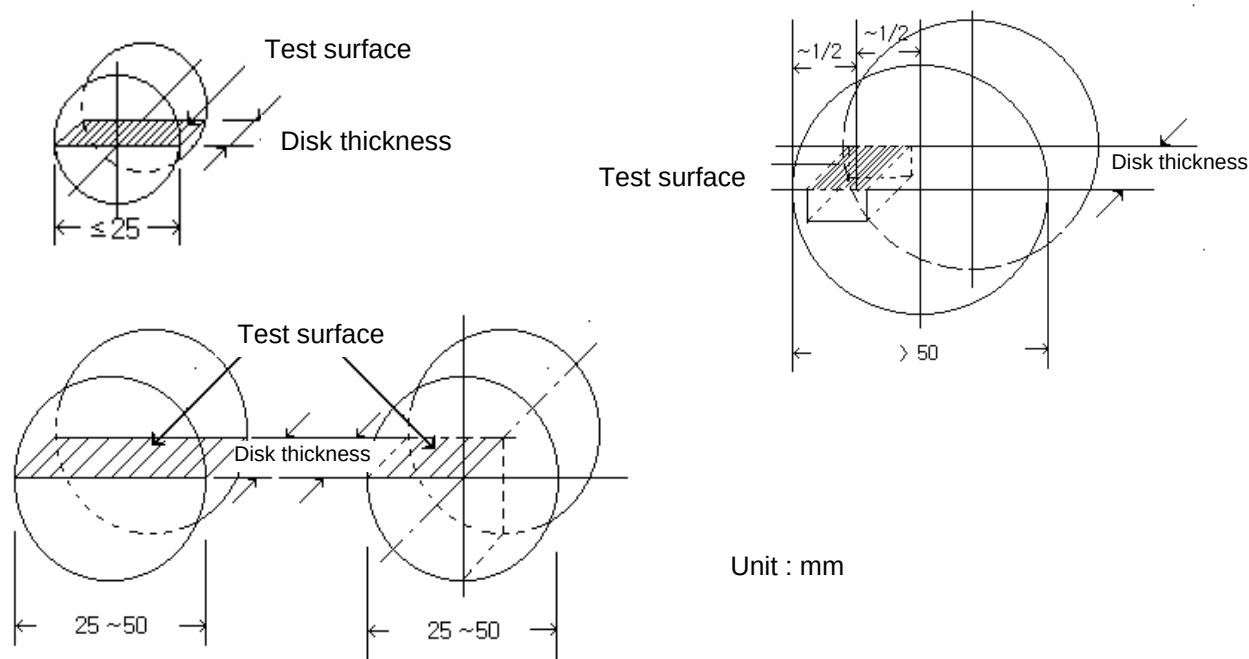


Fig. 1

3.1.2. Size of test surface

Method M : Minimum 150mm²

Method K : Minimum 100mm²

3.2. Sampling and preparation of test piece

3.2.1. At the time of sampling, it shall be noticed that the kind, size, form, quantity and distribution of non-metallic inclusions depend on the kind of steels, melting and casting method(including deoxidation method), the form and the size of raw ingot and the deformation.

3.2.2. The test sample shall be taken so that its slide surface shall be in parallel with the machining direction of crystal grain and in the longitudinal side including the center of the product.

If necessary, the position of slide-surface and sampling may be indicated in drawings.

- 1) This test is conducted only at approval and change in physical properties
- 2) Ball : Cut across the pole plane after checking the pole by soaking in 50% hydrochloric acid.
- 3) coil and leaf spring : cut out in the longitudinal direction (minimum length : 20 mm, minimum cross section : 200 mm²)

However, for the multi-leaf spring, each leaf shall be cut out in the longitudinal direction and evaluated.

3.2.3. At the time of test piece preparation, treat the sample carefully lest original form of inclusions should be changed.

3.3. Number of test piece

In principle, sample one test piece from one test sample.

For routine quality supervision and sampling from the initial product, at least one min. of test sample is required.

4. APPARATUS

4.1. Test equipment for microscopic measurement

4.1.1. Optical microscope with a magnification of 100X

The area of measurement to be observed shall have the same optical size as that of the figure of $\psi 80$ mm in table to be compared with it.

4.1.2. Test sample holder or mounting equipment for holding or mounting test samples.

4.1.3. Grinding and polishing equipment.

5. SUPPLEMENT

5.1. Figure series table

5.1.1. Series(vertical)

The figure series table listed in the supplement of this test method is composed of 10 individual figure series of inclusions with different kinds and forms.

SS :	Line form of sulfides(sulfide type)	:2 figure series
OA :	Dissolved form of oxide(alumina type)	:3 figure series
OS :	Line form of oxide(silicated type)	:3 figure series
OG :	Globular form of oxide(globular type)	:2 figure series

Among these main groups, line 1, 3, 6, 8 shall be regarded as base lines, the rest are derived forms of base lines, which shall be the reference to calculate the thickness and diameter of certain inclusions.

5.1.2. Lines(horizontal)

(1) The figure series table grasps, on the one hand, inclusions of very small size, melted according to special method(characteristic number 0) and on the other hand, up to inclusions (characteristic number 8) with length which exceeds the sight of the microscope with a vision field of 80 μm under the magnification of 100 times. Characteristic number is given to inclusions of 1.5 μm min. under microscope and indicates the length and diameter of characteristic inclusions by corresponding average effective area determined by length and diameter to figure series table respectively.

(2) Characteristics for lines

- 1) If listed in a line, inclusions of different kinds have the same area.
- 2) Area between two consecutive lines is double.
- 3) Different inclusions in a line have the same fine ratio(Ratio of length to width)
- (3) The numerical value 1 in mm under the individual vision field means the respective effective area for the length or the diameter of characteristics, nonmetallic inclusions.
- (4) Nonmetallic inclusions of a same size and shape shall be listed in a same figure series table.

5.2. Table 1

This table describes very small line-shaped non-metallic inclusions showing structural breaks in its total length. This table 1 lists the length ℓ determined by width b and determines lines which correspond to those of figure series table and evaluate by comparison with figure series table according to area.

6. TEST METHOD

- 6.1. Observe the test surface under the magnification of 100 times.
- 6.2. All remarkable inclusions shall be observed for testing.
- 6.3. Correspond inclusions of a measuring area to the pictures most similar to each in Figure series Table by comparing one another.
- 6.4. Interrupted inclusions