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**Macrostructure assessing method for solidification  
structure of continuous casting blank**

连铸钢坯凝固组织低倍评定方法

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# Macrostructure assessing method for solidification structure of continuous casting blank

## 1 Scope

This Standard specifies specimen preparation, classification and evaluation of solidification structure and inspection report for macrostructure assessing for solidification structure of continuous casting blanks.

This Standard is applicable to macrostructure assessing for solidification structure of continuous casting blanks (such as square billets, slabs, round billets, rectangular billets and shaped billets).

## 2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrigendum) or revisions do not apply to this Standard, however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 226-1991, *Etch test for macrostructure and defect of steels* (GB/T 226-1991, neq ISO 4969:1980 Steel-Macroscopic examination by etching with strong mineral acids)

## 3 Specimen preparation

**3.1** The method of interception and corrosion of the specimen shall comply with the provisions of GB/T 226-1991.

**3.2** The interception and preparation of dendritic corrosion specimens shall comply with the provisions of Annex A.

## 4 Classification and assessing of solidification structure

### 4.1 Fine equiaxed crystal bands

**4.1.1 Morphological features:** The microstructure of the fine equiaxed crystal bands near the surface of the continuous casting blank is dense, without orientation. No fine structure can be observed visually. A lighter layer of uniform tissue appears.

**4.1.2 Causes:** Near the upper meniscus of the mold, the molten steel is in close contact with the inner wall of the mold. The crystallizer has a strong endothermic and heat dissipation effect. Molten steel is chilled. The nucleation rate is greater than the nucleation growth rate. Fine equiaxed crystal bands are formed. The thickness of the fine equiaxed crystal bands depends on the superheat of the molten steel and the cooling intensity of the mold.

**4.1.3 Assessing principle:** Calculate the percentage of the area of the fine equiaxed crystal band in the entire inspection surface of the specimen, that is the fine equiaxed crystallinity. It can also use a ruler (or computer measuring software) to measure the multi-point thickness of small equiaxed crystal bands. Provide thickness ranges and average thickness values for fine equiaxed crystal bands.

## **4.2 Columnar crystal bands**

**4.2.1 Morphological features:** Columnar crystals are aggregates of dendrites. Generally, it grows inward vertically to the surface of the continuous casting blank, from simply to complex, from thin to thick. The secondary crystals are grown from the primary crystals, the tertiary crystals are grown from the secondary crystals, until the multiple crystals are grown.

**4.2.2 Causes:** The continuous casting blank enters the secondary cooling zone. The surface is strongly cooled by water or gas-water. It causes a large temperature gradient between the surface of the continuous casting blank and the liquid core part. One-way heat transfer that is vertical to the continuous casting blank surface is formed. The fastest crystal growth direction is parallel to the heat flow. It suppresses the growth of adjacent crystals and preferentially grows. Columnar crystal bands are formed.

**4.2.3 Assessing principle:** Calculate the percentage of the area of columnar crystals (including inclined columnar crystals without cross mosaic) in the entire inspection surface of the specimen, that is, the columnar crystal rate.

## **4.3 Equiaxed crystal bands**

**4.3.1 Morphological features:** Equiaxed crystal (central equiaxed crystal) bands are banded in the center of the continuous casting blank. They are round, oval, polygonal, and also have short strip-shaped grains, without orientation.

**4.3.2 Causes:** The temperature difference between the molten steel and the columnar crystal front in the central part of the continuous casting blank

## **Annex A**

(normative)

### **Preparation for dendritic corrosion specimen**

The dendritic corrosion method is one of the macrostructure inspection methods for showing the solidification dendritic structure of the blank by cold acid etching.

#### **A.1 Sampling and specimen processing**

##### **A.1.1 Sampling**

The sampling method shall be specified in the product standard or technical agreement. If not specified in the product standard or technical agreement, the sampling method can be implemented according to the following regulations:

- a) Take the continuous casting blank specimens under the stable conditions of the corresponding casting process parameters, which represent conventional sampling;
- b) Take transverse full-section specimens.

##### **A.1.2 Specimen processing**

The reference dimension of the continuous casting blank inspection surface from the cutting surface is:

- a) Not less than 20mm when hot sawing;
- b) Not less than 20mm when flame cutting the hot blank;
- c) Not less than 25mm when flame cutting the cold blank;
- d) Not less than 15mm when cold saw cutting the cold blank.

##### **A.1.3 Specimen testing surface requirements**

**A.1.3.1** The specimen shall be milled by a milling machine or planed by a planer first. The roughness  $R_a$  of the testing surface of the specimen shall not be greater than  $2.5\mu\text{m}$ . And then use a grinder to grind. The roughness  $R_a$  of the testing surface of the specimen shall not be greater than  $0.8\mu\text{m}$ .

**A.1.3.2** Polished specimens shall be polished. The roughness  $R_a$  of the testing surface of the specimen shall not be greater than  $0.1\mu\text{m}$ .

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