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Steel - Determination of microstructure

钢的显微组织评定方法

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1 Subject content and scope of application

This Standard specifies the metallographic determination method, determination principles and structural characteristics of free cementite, pearlite of low-carbon deformed steels, banded structure and Widmannstatten structure of steels.

This Standard applies to the determination of microstructure of steel plates, steel strips and sections of low-carbon and medium-carbon steels. Other steel types can be determined with reference to this Standard according to relevant standards or agreements.

2 Reference

GB/T 13298 Inspection methods of microstructure for metals

3 Cutting and preparation of specimens

The cutting and preparation of specimens shall be carried out in accordance with the relevant provisions of GB/T 13298.

4 Determination method of microstructure

4.1 The magnification for determination of free cementite and pearlite is 400× (360 ~ 450× is allowed). The magnification for determination of banded structure and Widmannstatten structure is 100× (95 ~ 110× is allowed).

4.2 The standard field of view diameter is 80 mm.

4.3 The determination is carried out by comparison with the corresponding standard rating diagrams.

4.4 The two surface layers with a depth of approximately 10 % of the thickness of the steel plate are not inspected.

4.5 When rating, it shall select the highest level in each field of view on the grinding surface for determination.

4.6 The determination results are expressed by levels. If the level characteristics are between the adjacent 2 levels, a half level can be attached. If necessary, the series letter shall be marked, such as 1A, 3B.

5 Determination principles of microstructure

5.1 Free cementite (rating diagrams are shown in Annex A1)

For the determination of free cementite of low-carbon annealed steels with a carbon content of less than or equal to 0.15 %, it is determined based on the shape, distribution and size characteristics of cementite.

Table 1 is the description of the structural characteristics of which the rating diagrams are shown in Annex A1. It consists of each 6 levels in 3 series.

A series: It is determined according to the principle of forming cementite networks at grain boundaries. The ratio of the part surrounded by cementite networks at the periphery of individual ferrite grains is used as the determination principle.

B series: It is determined according to the principle of free cementite granules constituting single-layer, double-layer and multi-layer chains of different lengths and increase in granule size.

C series: It is determined according to the principle of transition from evenly distributed dotted cementite to uneven banded structure.

5.2 Pearlite of low-carbon deformed steels (rating diagrams are shown in Annex A2)

For the determination of pearlite of low-carbon deformed steels with a carbon content of 0.10 % to 0.30 %, it is determined according to the structure (granular, fine granular pearlite colony or lamellar), quantity and distribution characteristics of pearlite.

Table 2 is the description of the structural characteristics of which the rating diagrams are shown in Annex A2. It consists of each 6 levels in 3 series.

A series: It is designated for the rating of granular pearlite of cold-rolled steels with a carbon content of 0.10 % to 0.20 %. As the level increases, cementite granules aggregate and tend to form bands.

B series: It is designated for the rating of fine granular pearlite colonies of hot-rolled steels with a carbon content of 0.1 % to 0.20 %. As the level increases, granular pearlite transitions to lamellar pearlite that forms deformation bands (and forms split bands).

C series: It is designated for the rating of pearlite of hot-rolled steels with a carbon content of 0.21 % to 0.30 %. As the level increases, fine lamellar pearlite transitions from uneven-size and evenly distributed colony structure to uneven banded structure. At this time, it must be determined based on the width of the continuous band composed of aggregated pearlite.

5.3 Banded structure (rating diagrams are shown in Annex A3)

For the determination of banded structure of pearlitic steels, it is determined according to the increase in the quantity of banded ferrites, considering the degree and continuity of banded structure that passes through the field of view, and the quantity of deformed ferrite grains.

Table 3 is the description of the structural characteristics of which the rating diagrams are shown in A3. It consists of each 6 levels in 3 series.

A series: It is designated for the rating of banded structure of steels with a carbon content of 0.15 % or less.

B series: It is designated for the rating of banded structure of steels with a carbon content of 0.16 % to 0.30 %.

C series: It is designated for the rating of banded structure of steels with a carbon content of 0.31 % to 0.50 %.

5.4 Widmannstatten structure (rating diagrams are shown in Annex A4)

For the determination of Widmannstatten structure of pearlitic steels after overheating, it is determined according to the quantity and size of acicular ferrite precipitated and the size of austenite grains determined by ferrite networks.

Table 4 is the description of the structural characteristics of which the rating diagrams are shown in Annex A4. It consists of each 6 levels in 2 series.

A series: It is designated for the rating of Widmannstatten structure of steels with a carbon content of 0.15 % to 0.30 %.

B series: It is designated for the rating of Widmannstatten structure of steels with a carbon content of 0.31 % to 0.50 %.

Table 1 -- Free cementite

Level	Structural characteristics		
	A series	B series	C series
0	Free cementite is granular with a size of ≤ 2 mm, evenly distributed	Free cementite is dotted or small granular, tending to constitute single-layer chains	Free cementite is dotted or small granules, evenly distributed, slightly oriented in the deformation direction

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