

ICS 29.050

YB

**INDUSTRY STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

YB/T 5222-2014

**Quality hot rolled and forged carbon structural steel round tube
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优质碳素结构钢热轧和锻制圆管坯

(English Translation)

Issued on: December 20, 2023

Implemented on: July 1, 2004

**Issued by: Ministry of Industry and Information Technology of the
People's Republic of China**

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Foreword

This document was drafted in accordance with the rules given in GB/T 1.1-2020

"Directives for standardization - Part 1: Rules for the structure and drafting of standardizing documents".

YB/T 6139 "Test methods for graphite-type negative electrode materials" is divided into the following two parts:

- Part 1: Determination of graphitization;
- Part 2: Determination of oil absorption value.

This document is Part 1 of YB/T 6139.

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This document was proposed by China Iron and Steel Association.

This document shall be under the jurisdiction of National Technical Committee on Steel of Standardization Administration of China (SAC/TC 183).

The drafting organizations of this document: B&T New Materials Group Co., Ltd., Guangdong Brunp Recycling Technology Co., Ltd., Shanxi Coal Chemistry Research Institute of the Chinese Academy of Sciences, Henan Yicheng Hanbo Energy Technology Co., Ltd., and Metallurgical Industry Information Standards Research Institute.

Main drafters of this document: Wang Yuhui, Sun Hua, Zhang Ruifang, Xie Yinghao, Huang Xianhong, Cui Qiang, Zhang Nan, Wang Xiaoyuan, Tang Jianxiao, Yu Hongxing, Li Zikun, Dai Haitao, Li Fei, Huang Youyuan, Zhang Qinglai.

This document is first issued.

Test methods for graphite-type negative electrode materials -

Part 1: Determination of graphitization

1 Scope

This document specifies terms and definitions, principles, test procedures, precision, test reports for determination methods for graphitization of graphite-type negative electrode materials.

This document is applicable to the determination of the graphitization degree of graphite negative electrode materials using X-ray diffractometer (XRD).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 8170, Rules of rounding off for numerical values and expression and judgement of limiting values

GB/T 24533, Graphite negative electrode materials for lithium ion battery

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 graphitization degree

Graphite has a layered structure. The carbon atoms in each layer form a three-coordinated hexagonal mesh plane with an angle of 120° to each other in the shape of sp^2 hybrid orbitals. The mesh plane is parallel to the layer, forming a hexagonal graphite crystal. The degree to which carbon atoms form a hexagonal graphite crystal structure is called the graphitization degree. The graphitization degree is represented by the letter G. The value of G is expressed as a percentage (%).

[Source: Carbon Terminology Dictionary]

4 Principle

When X-rays are projected into graphite crystals, they are scattered by atoms and electrons in the crystals. Due to the periodic arrangement of atoms in the crystals, there is a fixed phase difference between these scattered waves, which interfere in space, causing the scattered waves to reinforce each other in some scattering directions and cancel each other out in some directions, thus causing diffraction. The diffractometer automatically records the diffraction pattern of the sample and analyzes the diffraction pattern to obtain sample information.

Crystalline silicon (the diffraction angle of the 111 plane is 28.442°) is used as an internal standard. By adding crystalline silicon to the sample to be tested, the diffraction angle of the (002) plane in the graphite crystal can be accurately located (at around 26.5°). The graphite interlayer spacing (d_{002}) is calculated using the Bragg equation. The graphitization degree is then calculated using the Franklin equation.

6.1 X-ray diffractometer: Cu target, diffraction angle accuracy $\leq \pm 0.02^\circ$; diffraction

angle repeatability $\leq 0.002^\circ$;

7 Sample

The samples shall comply with the requirements of GB/T 24533.

8.1 Test conditions

Laboratory environment temperature: $(23\pm 5)^{\circ}\text{C}$; humidity: $\leq 60\%\text{RH}$. The equipment and reagents used shall be kept under laboratory environment conditions for 24 h.

8.2 Sample preparation

According to the intensity ratio of the graphite (002) peak and the silicon powder (111)

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