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Fiber laser

光纤激光器

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Fiber laser

1 Scope

This standard specifies the terms and definitions, classification, technical requirements, test methods, inspection rules, markings, packaging, transportation and storage of fiber lasers (hereinafter referred to as lasers).

This standard applies to the development, production, delivery of fiber lasers.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this standard.

GB/T 191 Packaging - Pictorial marking for handling of goods

GB/T 2423.1 Environmental testing for electric and electronic products - Part 2: Test methods - Tests A: Cold

GB/T 2423.2 Environmental testing for electric and electronic products - Part 2: Test methods - Tests B: Dry heat

GB/T 2423.3 Environmental testing for electric and electronic products - Part 2: Testing method test Cab: Damp heat Steady state

GB/T 2423.5 Environmental testing for electric and electronic products - Part 2: Test methods Test Ea and guidance: Shock

GB/T 2423.6 Environmental testing for electric and electronic products - Part 2: Test methods - Test Eb and guidance: Bump

GB/T 2423.10 Environmental testing - Part 2: Test methods - Test Fc: Vibration (sinusoidal)

GB/T 2828.1 Sampling procedures for inspection by attributes - Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

GB 2894 Safety signs and guidelines for the use

GB/T 4798.2 Environmental conditions existing in the application of electric and electronic products - Section 2: Transportation

GB 6388 Transport package shipping mark

GB 7247.1 Safety of laser products - Part 1: Equipment classification and requirements

GB/T 7247.13 Safety of laser products - Part 13: Measurements for classification of laser products

GB/T 10320 Electrical safety of laser equipment and installations

GB/T 14733.12 Terminology for telecommunication - Optical communication

GB/T 15175-2012 Measurement methods for main parameter of solid state lasers

GB/T 15313-2008 Terminology for laser

3 Terms and definitions

The terms and definitions as defined in GB/T 14733.12, GB/T 15175-2012, GB/T 15313 as well as the following terms and definitions apply to this document. For ease of use, some terms and definitions in GB/T 15313 are listed repeatedly below.

3.1

Fiber laser

A laser that uses a fiber doped with activated particles as the laser medium.

[GB/T 15313-2008, definition 2.4.35]

3.2

Laser beam delivery optics

Optical cable with fiber protector and connector for transmitting laser energy.

3.3

Beam quality

A physical quantity used to describe the spatial transmission characteristics and focusing performance of a laser beam, usually expressed in terms of beam transmission ratio (M^2) or beam parameter product (BPP).

- b) The laser mark shall be firm and clear. The laser's safety and grade requirement mark shall meet the requirements of GB 2894 and GB 7247.1;
- c) The external interface of the laser shall be firm and reliable, without any signs of loosening;
- d) The size of the screws, nuts and pins used in the threaded connector of the laser shall comply with the detailed specifications;
- e) Other requirements specified in the detailed specification.

5.2 Performance parameter requirements

5.2.1 Performance parameters of continuous fiber laser

Unless otherwise specified, the following relevant parameters shall be specified in the detailed specification of continuous fiber lasers. The parameters shall meet the requirements of the detailed specification after being measured by the specified measurement method (see 6.3):

- a) Wavelength;
- b) Spectral width (when applicable);
- c) Continuous output power;
- d) Beam quality;
- e) Instability of output power;
- f) Degree of polarization (when applicable);
- g) Beam diameter (when applicable);
- h) Output fiber core's diameter (when applicable);
- i) Electro-optical conversion efficiency (when applicable);
- j) Other requirements specified in the detailed specification.

5.2.2 Performance parameters of pulsed fiber laser

Unless otherwise specified, the following relevant parameters shall be specified in the detailed specifications of pulsed fiber lasers. Their parameters shall meet the requirements of the detailed specifications after being measured by the specified measurement method (see 6.3):

- a) Wavelength;

pressure, temperature control, air volume, etc.;

d) The minimum bend radius (or diameter) of the output fiber or cable;

e) Other requirements specified in the detailed specification.

5.5 Environmental adaptability

5.5.1 General

Unless otherwise specified, the laser shall meet the following environmental conditions and meet the corresponding requirements. For lasers with special structures, proper protection can be carried out, if not affecting the test results, before the test.

5.5.2 High-temperature work

5.5.2.1 Conditions

The ambient temperature and continuous working time are selected from the following conditions:

a) Ambient temperature: 30 °C, 40 °C, 55 °C, 70 °C, 85 °C;

b) Continuous working time: 2 h, 16 h, 72 h, 96 h.

5.5.2.2 Requirements

During and after the high-temperature work test, the laser performance parameters shall be tested in accordance with the detailed specifications of the laser. The test results shall meet the detailed specifications of the laser.

5.5.3 Low-temperature work

5.5.3.1 Conditions

The ambient temperature and continuous working time are selected from the following conditions:

a) Ambient temperature: 0 °C, -5 °C, -10 °C, -25 °C, -40 °C, -55 °C;

b) Continuous working time: 2 h, 16 h, 72 h, 96 h.

5.5.3.2 Requirements

In the low-temperature work test and after the test, the laser performance parameters are tested according to the detailed specifications of the laser. The test results shall meet the requirements of the detailed specifications of the exciter.

5.7.1 Radiation safety and protection

The radiation safety and protection of the laser shall meet the requirements of GB 7247.1. Especially for 1 μm band lasers, the radiation safety and protection in the development, production and application shall be specified in the detailed specifications.

5.7.2 Electrical safety and protection

The electrical safety and protection of the laser shall meet the requirements of GB/T 10320.

6 Test method

6.1 General requirements

6.1.1 General

Unless otherwise specified, the laser under test shall work stably under the working conditions specified in the detailed specification. It shall take necessary protective measures in accordance with the requirements of the detailed specification.

6.1.2 Environmental requirements

Unless otherwise specified, the test shall be carried out under the following conditions:

- a) Atmospheric pressure: 86 kPa ~ 106 kPa;
- b) Ambient temperature: 15°C ~ 35°C;
- c) Relative humidity: 30% ~ 70%;
- d) Air cleanliness: In accordance with the product specification.

6.1.3 Test instrument and measurement requirements

Unless otherwise specified, the test instrument shall meet the following requirements:

- a) The range of the test instrument meets the parameter range of the tested laser;
- b) It meets the requirements of measurement verification and is within the validity period of measurement.

6.2 Visual inspection

provisions of GB/T 4798.2.

6.6 Reliability test

The reliability test of the laser shall be carried out in accordance with the detailed specifications of the laser and meet the requirements of reliability (see 5.6).

6.7 Safety test

The safety test of the laser shall meet the following requirements:

- a) The radiation safety and protection test of the laser complies with the regulations of GB 7247.13;
- b) The testing method for the electrical safety requirements of the laser shall meet the requirements of GB/T 10320.

7 Inspection rules

7.1 General

Unless otherwise specified, the manufacturer shall be responsible for completing all inspections specified in this standard and detailed specifications.

7.2 Inspection classification

The inspection is divided into:

- a) Identification inspection (see 7.4);
- b) Delivery inspection (see 7.5);
- c) Routine inspection (see 7.6).

7.3 Inspection items and classification

Laser inspection items, inspection requirements and test methods are as shown in Table 5.

7.4.2 Timing

Identification inspection shall be carried out in one of the following situations:

- a) Newly developed laser;
- b) In order to comprehensively evaluate whether the quality of the new laser meets the technical requirements and whether the factory has the capacity and means for mass production;
- c) After the laser is officially produced, major changes such as structure, materials, and processes may affect the performance of the laser.

7.4.3 Rules

Unless otherwise specified, the samples for identification inspection shall not be less than 3, of which the appearance, performance parameters, safety and protection items in Table 5 must all be inspected; the environmental adaptability items shall use not less than 2 samples. Perform inspection according to the test methods quoted in the "Test Method" column of Table 5; if each test result meets the requirements specified in the "Inspection requirements" column of Table 5, the laser is determined to be qualified. During the inspection process, if one of the inspection items of 1 sample does not meet the requirements, the laser qualification inspection is determined to be unqualified. If the inspection is unqualified, after finding out the reason, improving the process and reorganizing the production, it may apply for the identification inspection again.

7.5 Delivery inspection

7.5.1 Timing

It is suitable for the delivery inspection of batch products by the inspection department and the delivery inspection of products from the ordering party to the supplier.

7.5.2 Rules

New lasers or lasers that need to be repeatedly inspected are selected as inspection samples in accordance with the requirements of GB/T 2828.1. For the inspection items selected in the "Delivery inspection" column of Table 5, follow the inspection method as cited in the "Inspection Method" column of Table 5 to carry out inspection item by item. If each inspection result meets the requirements specified in the "Inspection requirements" column of Table 5, the laser's delivery inspection is determined to be qualified. During the inspection process, if one of the inspection items does not meet the requirements, the laser's delivery inspection is determined to be unqualified. If the inspection is unqualified, after finding out the reason, improving the process and

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Contact: Wayne Zheng, Sales@ChineseStandard.net

Linkin: <https://www.linkedin.com/in/waynezhengwenrui/>

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