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Testing guidelines of fibre optic components for space application

空间用纤维光学器件测试指南

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1 Scope

This document provides guidance on the general principles of testing, the test items, the test methods and the points to note in testing fibre optic components for space use.

It applies to the testing of the fibre optic components used in fibre optic sensing, fibre optic communication and other optoelectronic systems intended for space application; other fields of application may follow it by reference.

Note: fibre optic components in this text include light emitting components and assemblies with a fibre pigtail, photodetector components and assemblies, and optical processing

components and assemblies.

2 Normative references

The contents of the following documents constitute indispensable provisions of this document through normative reference in the text. For dated references, only the edition corresponding to that date applies; for undated references, the latest edition, including all amendments, applies.

GB/T 12512-1990 Fibre optic attenuators - Part 1: Generic specification.

GB/T 13265.1-1997 Fibre optic isolators - Part 1: Generic specification.

GB/T 14733.12 Telecommunication terminology - Optical fibre communication.

GB/T 16850.1 Test methods for optical amplifiers - Part 1: Power and gain parameters of single channel optical amplifiers.

GB/T 16850.3 Test methods for optical amplifiers - Part 3: Noise parameters of single channel optical amplifiers.

GB/T 16850.4 Basic specification for test methods of optical fibre amplifiers - Part 4: Analogue parameters - Test method for gain slope.

GB/T 16850.5 Basic specification for test methods of optical fibre amplifiers - Part 5: Test method for reflectance parameters.

GB/T 16850.6 Basic specification for test methods of optical fibre amplifiers - Part 6: Test method for pump leakage parameters.

GB/T 16850.7 Basic specification for test methods of optical fibre amplifiers - Part 7: Test method for out-of-band insertion loss.

GB/T 18311.2 Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-2: Examinations and measurements - Polarization dependence of single mode fibre optic components.

GB/T 18311.4 Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-4: Examinations and measurements - Attenuation.

GB/T 18311.5 Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-5: Examinations and measurements - Wavelength dependence of attenuation.

GB/T 18311.6 Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-6: Examinations and measurements - Return loss.

GB/T 18311.40 Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-40: Examinations and measurements - Extinction

ratio of connectors with polarization maintaining fibre pigtails.

GB/T 24365-2009 Test methods for photodetector assemblies for communication.

GB/T 31359-2015 Test methods for semiconductor lasers.

GB/T 38313 Design and verification requirements for fibre optic components for aerospace use.

SJ/T 2749-2016 Test methods for semiconductor laser diodes.

SJ 20785-2000 Test methods for superluminescent light emitting diode assemblies.

SJ 20869-2003 Test methods for lithium niobate integrated optical waveguide modulators.

YD/T 894.2-2010 Technical specifications for optical attenuators - Part 2: Optical variable attenuators.

YD/T 964-1998 Technical requirements and test methods for 1 310 nm/1 550 nm wavelength division multiplexers.

YD/T 1689-2007 Technical requirements and test methods for mechanical optical switches.

YD/T 3128-2016 Fibre Bragg gratings based on wavelength detection for communication use.

3 Terms and definitions

The terms and definitions given in GB/T 14733.12 and GB/T 38313 apply to this document. No further term is defined here.

4 General principles

4.1 Purpose of the tests. Component testing has these purposes: a) to verify whether the component meets the requirements of its detail specification, of the user's technical documents or of the contract; b) to find defects in the component, so that its design and its production process can be improved; c) to find the causes of component failure, for use in product failure analysis.

4.2 Types of test. Component testing covers: a) normal temperature performance testing, that is testing the various performance indexes of the component in a normal temperature laboratory environment; b) environmental adaptability testing, that is testing the effect of specified environmental conditions on the performance indexes of the component, environmental conditions generally including temperature, mechanical conditions, vacuum and space irradiation. Note: where the test conditions allow, the test should as far as possible use real-time continuous acquisition.

4.3.1 Standard test atmospheric conditions: a) temperature 18 °C to 28 °C; b) air pressure

86 kPa to 106 kPa; c) relative humidity 30 % to 70 %.

4.3.2 Arbitration test atmospheric conditions. Where the parameters of the component under test depend on temperature, air pressure and humidity, the test should be carried out under the following arbitration conditions: a) temperature 25 °C +/- 1 °C; b) air pressure 86 kPa to 106 kPa; c) relative humidity 45 % to 55 %.

4.4 Test personnel should meet the following: a) they take part in testing work only after training and a post examination and after obtaining a post certificate; b) before each test they check the test instruments, the tools and the test working documents as specified, and only then carry out the test.

4.5 Test documents should meet the following: a) the documents on the test site are managed so that the site documents are complete and currently valid; b) the management of the test documents is carried out by a designated person who is not the one performing the test.

4.6 Test instruments should meet the following: a) they hold a valid verification certificate and are within its period of validity; b) the accuracy, the precision and the measuring range of the instruments on site meet the test requirements.

4.7 The test process should meet the following: a) checks are made from time to time on whether the test is being carried out according to the test guidance documents; b) where abnormal phenomena occur, or where the non-conforming components are rather numerous, the test should be stopped and the matter reported to the department concerned, the test being resumed once the cause has been found.

4.8 Drawing up of test documents. The test documents that should be drawn up over the whole course of the testing include the test outline, the test rules or test working instructions, the test data tracking card or record sheet, the test anomaly analysis report where there is one, and the test summary report.

5 Test items

5.1.1 Choice of test items for light emitting components and assemblies. These cover light emitting semiconductor laser diode sources and assemblies with a fibre pigtail (LD), superluminescent light emitting diode sources and assemblies (SLD) and erbium doped fibre light sources (ASE). The optoelectronic performance test items at normal temperature are given in Table 1.

Table 1 has four columns: component type, test item, test method and remarks. For LD it lists output optical power, tested by 5.1 of GB/T 31359-2015; peak power, by 5.3 of the same standard, with the remark pulsed laser; operating current, by 5.7; operating voltage, by 5.8; peak wavelength, by 5.13; centre wavelength, by 5.15, with the remark symmetrical spectrum; spectral width at minus 13 dB, by 5.14; side mode suppression ratio, by 5.22;