

JIS

JAPANESE INDUSTRIAL STANDARD

**Test methods of optical power
meters for optical fiber**

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In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

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Test methods of optical power meters
for optical fiber

C 6184-1993

1. Scope This Japanese Industrial Standard specifies test methods of optical power meters which have optical fiber connector terminals and are equipped with detector for optical fiber capable of measuring optical power over a wavelength range from 400 nm to 1800 nm.

Remarks: The standards cited in this Standard are as follows:

- JIS C 1002 Glossary of terms used in electronic measuring apparatus
- JIS C 1003 Testing methods for digital voltmeters
- JIS C 6820 General rules of optical fibers
- JIS Z 8103 Glossary of terms used in instrumentation
- JIS Z 8120 Glossary of optical terms

2. Definitions For the purposes of this Standard, in addition to the definitions specified in JIS C 1002, JIS C 6820, JIS Z 8103 and JIS Z 8120, the following principal definitions apply:

- (1) detector An apparatus which transduces optical power into electrical output.
- (2) detection surface The input portion of a detector which is a region effective for detecting light.
- (3) multiple reflection Such reflection that a part of incident light reflected at the detection surface of detector in optical power meter for optical fiber, is reflected at the internal surface of receptacle or the ferrule end surface of the inserted optical fiber connector, then a part or all of the light so reflected enters into the detection surface and the said reflection is repeated.

3. Standard test conditions Unless otherwise specified, the conditions at the tests of optical power meter for optical fiber (hereafter referred to as "specimen") shall be as stated below. If it is difficult to carry out the tests under the standard test conditions, the conditions employed and the influence shall be stated in the test results.

- (1) Temperature One of the temperatures given below shall be selected.
 $20 \pm 2^{\circ}\text{C}$, $23 \pm 2^{\circ}\text{C}$, $25 \pm 2^{\circ}\text{C}$
- (2) Relative humidity Either of the relative humidities given below shall be selected.
 $(50 \pm 10) \%$, $(65 \pm 10) \%$

(3) Fiber optic test source

Center wavelength: The center wavelength specified for the specimen

Optical power level: The optical power level specified for the specimen

Polarization: Linearly polarized light

(4) Optical fiber A single-mode optical fiber which has spherically grounded ferrule connector at its emergent end shall be employed.

Remarks: In the wavelength range where multimode appears, it is preferable to give bend and to use a mode filter which removes higher modes.

4. Outline of tests The test items shall be as given in Table 1.

Table 1. Outline of tests

Test item	Applicable clause for test method
Calibration error test	5.
Accuracy test	6.
Overload test	7.
Strength test	8.

5. Calibration error test

5.1 Outline of calibration error test Carry out the test by relative measurement to the inspection standard, at the wavelength and the power level specified for the specimen. The inspection standard referred here means one of the standards given below.

- (1) Standards calibrated by the national standard.
- (2) Standards calibrated by an official organization performing calibration business.
- (3) Standards which have been calibrated by means of the standard stated in (1) or (2).

5.2 Calculation method of calibration error Obtain the limit of error of the inspection standard after correction of its bias, the dispersion of relative calibration in 5.3, and the partial errors in % from the individual error tests of 5.4, and calculate the calibration error of the specimen from the following formula.

When the inspection standard corresponds to the standard specified in 5.1 (2), use the test accuracy (indicated by %) at confidence coefficient 95 % guaranteed by the official organization as the limit of error of the inspection standard.

$$\varepsilon_{cx} (\%) = \pm 2 \sqrt{\left(\frac{\varepsilon_{sx}}{2}\right)^2 + \varepsilon_{cs}^2 - \sum_{i=1}^m \varepsilon_{ci}^2}$$

where, ε_{cx} : calibration error (%)
 ε_{sx} : limit of error of inspection standard after correction of bias (%)
 providing, the value at twice standard deviation and confidence coefficient 95 %
 ε_{cs} : dispersion of relative calibration (%)
 ε_{ci} : standard deviation of partial error (%)

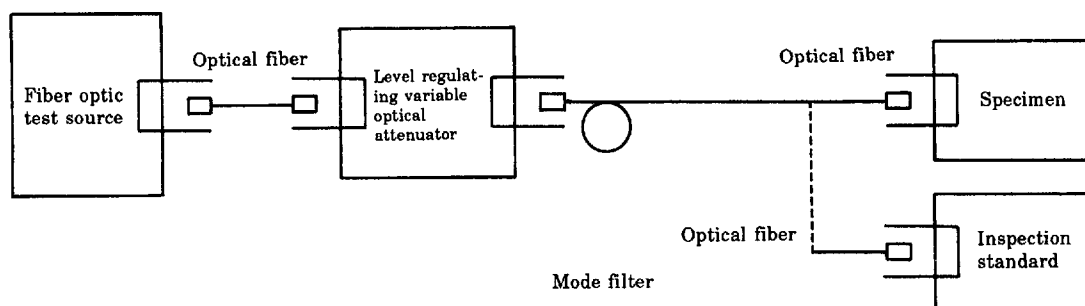
$$\frac{\varepsilon_{cui} - \varepsilon_{cli}}{2\sqrt{3}}$$

where, ε_{cui} : upper limit of partial error (%)
 ε_{cli} : lower limit of partial error (%)

m : number of partial errors

5.3 Relative calibration Carry out the relative calibration of the specimen to the inspection standard in the procedures given below. The calibration point of the specimen shall be in the power level at which the inspection standard has been calibrated. An example of measuring system is shown in Fig. 1.

Fig. 1. Measuring system for relative calibration (example)



- (1) Connect the specimen to the end of optical fiber.
- (2) Bring the power level to the calibration point of the specimen, by adjusting the output of fiber optic test source using the level regulating variable optical attenuator.
- (3) Disconnect the specimen and connect the inspection standard to the end of optical fiber.
- (4) Measure the power level with the inspection standard.
- (5) Repeat the procedures (1) to (4) at least 10 times (m times).

Calculate the dispersion of relative calibration from the following formula:

$$\varepsilon_{cs} (\%) = \frac{1}{\bar{x}} \sqrt{\frac{\sum_{i=1}^m (x_i - \bar{x})^2}{m - 1}} \times 100$$

where, ε_{cs} : dispersion of relative calibration (%)

x_i : measured value

$\bar{x}$: average of measured values

$$\bar{x} = \frac{\sum_{i=1}^m x_i}{m}$$

m : number of measurements

5.4 Individual error test

5.4.1 Test items Carry out the error tests for the following items and calculate the limits of partial errors:

- (1) Wavelength dependence
- (2) Optical polarization dependence

The output power and wavelength of fiber optic test source for use in each test shall be sufficiently stable to carry out the test.

- Remarks
1. The inspection standard shall be capable of correcting the error due to difference in the standard test conditions (bias due to difference of standard test conditions at calibration of the inspection standard from that at calibration of the specimen)
 2. When the specimen is a thermal type optical power meter, the tests of (1) and (2) may be omitted.

5.4.2 Wavelength dependence Carry out the wavelength dependence test by comparing the specimen with an inspection standard which is wavelength independent or whose wavelength dependence is known, using a light source whose wavelength is variable.

Change the wavelength within the tolerance width of center wavelength, obtain the quotient of the measured value by the specimen and the measured value by the inspection standard at each wavelength, and calculate the upper limit and the lower limit of partial error from the formulae given below, respectively.

In such a case that the calibration data of sensitivity to wavelength are attached as a graph, or the specimen indicates the value after correction by means of the calibration data, the value after correction shall be considered as the measured value by the specimen.

$$\varepsilon_{cul} (\%) = \frac{R_1 - R_0}{R_0} \times 100$$

$$\varepsilon_{cli} (\%) = \frac{R_2 - R_0}{R_0} \times 100$$