

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Optical fibre cables –
Part 1-20: Generic specification – Basic optical cable test procedures – General
and definitions**

**Câbles à fibres optiques –
Partie 1-20: Spécification générique – Procédures fondamentales d'essais des
câbles optiques – Généralités et définitions**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPTICAL FIBRE CABLES –

**Part 1-20: Generic specification –
Basic optical cable test procedures –
General and definitions**

FOREWORD

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International Standard IEC 60794-1-20 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This first edition of IEC 60794-1-20 cancels and replaces the general and guidance part of the second edition of IEC 60794-1-2 published in 2003. It constitutes a technical revision.

It has been decided to split the second edition of IEC 60794-1-2 into six new documents:

- IEC 60794-1-2:2003, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures (second edition)*
- IEC 60794-1-2:2013, *Optical fibre cables – Part 1-2: Generic specification – Cross reference table for optical cable test procedures (third edition)*
- IEC 60794-1-20, *Optical fibre cables – Part 1-20: Generic specification – Basic optical cable test procedures – General and definitions*

- IEC 60794-1-21, *Optical fibre cables – Part 1-21: Generic specification – Basic optical cable test procedures – Mechanical tests methods*
- IEC 60794-1-22, *Optical fibre cables – Part 1-22: Generic specification – Basic optical cable test procedures – Environmental tests methods*
- IEC 60794-1-23, *Optical fibre cables – Part 1-23: Generic specification – Basic optical cable test procedures – Cable elements tests methods*
- IEC 60794-1-24, *Optical fibre cables – Part 1-24: Generic specification – Basic optical cable test procedures – Electrical tests methods*

This standard is intended to be used in conjunction with IEC 60794-1-1: *Optical fibre cables – Part 1-1: Generic specification – General*.

The text of this standard is based on the following documents:

CDV	Report on voting
86A/1476/CDV	86A/1514/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 61754 series, under the general title *Optical fibre cables*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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OPTICAL FIBRE CABLES –

Part 1-20: Generic specification – Basic optical cable test procedures – General and definitions

1 Scope and object

This part of IEC 60794 applies to optical fibre cables for use with telecommunication equipment and devices employing similar techniques, and to cables having a combination of both optical fibres and electrical conductors.

The object of this standard is to define test procedures to be used in establishing uniform requirements for the geometrical, transmission, material, mechanical, ageing (environmental exposure) and climatic properties of optical fibre cables, and electrical requirements where appropriate.

Throughout this standard the wording “optical cable” may also include optical fibre units, microduct fibre units, etc.

2 Normative references

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

IEC 60793-1 (all parts 1), *Optical fibres – Measurement methods and test procedures*

IEC 60793-1-40, *Optical fibres – Measurement methods and test procedures – Attenuation*

IEC 60793-1-41, *Optical fibres – Part 1-41: Measurement methods and test procedures – Bandwidth*

IEC 60793-1-46, *Optical fibres: Measurement methods and test procedures – Monitoring of changes in optical transmittance*

IEC 60793-1-48, *Optical fibres – Part 1-48: Measurement methods and test procedures – Polarization mode dispersion*

IEC 60793-2 (all parts), *Optical fibres*

IEC 60793-2-10, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibres*

IEC 60793-2-40, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A4 multimode fibres*

IEC 60793-2-50, *Optical fibres – Part 2-10: Product specifications – Sectional specification for class B single-mode fibres*

IEC 60794-1 (all parts), *Optical fibre cables – Part 1: Generic specification*

IEC 60794-1-1, *Optical fibre cables – Part 1-1: Generic specification – General*

IEC 60794-1-2:2013, *Optical fibre cables – Part 1-2: Generic specification – Cross reference table for optical cable test procedures (third edition)*

IEC 60794-2 (all parts), *Optical fibre cables – Part 2: Indoor cables*

IEC 60794-3 (all parts), *Optical fibre cables – Part 3: Outdoor cables*

IEC 60794-3-20, *Optical fibre cables – Part 3-20: Outdoor cables – Family specification for self-supporting aerial telecommunication cables*

IEC 60794-4, *Optical fibre cables:– Part 4: Aerial optical cables along electrical power lines*

IEC 60794-5, *Optical fibre cables – Part 5: Sectional specification – Microduct cabling for installation by blowing*

IEC 61931, *Fibre optic – Terminology*

IEC/TR 62362, *Selection of optical fibre cable specifications relative to mechanical, ingress, climatic or electromagnetic characteristics – Guidance*

ISO/IEC 98-3, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC Guide 99, *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*

ISO/IEC 11801, *Information technology – Generic cabling for customer premises*

<https://standards.iteh.ai/catalog/standards/sist/520011c7-6e95-47a4-a977-11d0cd2c409e/iec-60794-1-20-2014>

3 Terms and definitions

For the purposes of this document, the terms and definitions in the IEC 60793-2 series, as well as the following, apply.

3.1 Common terms

3.1.1

multimode fibre

MMF

fibre conforming to IEC 60793-2-10

3.1.2

single-mode fibre

SMF

fibre conforming to IEC 60793-2-50

3.1.3

plastic optical fibre

POF

fibre conforming to IEC 60793-2-40

3.1.4

low water peak

LWP

fibre – single-mode fibre conforming to IEC 60793-2-50, category B1.3

3.1.5

bend-insensitive fibre

single-mode fibre conforming to IEC 60793-2-50, category B6

3.1.6

laser optimized multimode fibre

multimode fibre conforming to IEC 60793-2-10, implementations A1a.2 or A1a.3

3.2 Cable definitions

For the purposes of this document, the terms and definitions in IEC 60794-1-1, IEC 60794-2, IEC 60794-3, IEC 60794-4 and IEC 60794-5 apply.

3.3 Ribbon definition

3.3.1

ribbon

several optical fibres, typically 4, 8 and 12, joined together in a flat formation.

4 General and guidance

4.1 General

Not all tests are required for a cable design. It depends on the application and the detail specification.

4.2 Test procedure format

The standard order of each test method is in general as follows. Additional clauses may be inserted, whilst maintaining this general order:

- object;
- sample;
- apparatus;
- procedure;
- requirement;
- details to be specified;
- details to be reported.

4.3 Standard atmospheric conditions

Two sets of allowable ambient conditions for cable testing are defined for use in testing in this specification:

4.4 Standard test conditions

- temperature $+23\text{ °C} \pm 5\text{ °C}$;
- pressure site ambient;
- relative humidity 20 % to 70 %.

4.5 Expanded test conditions

- temperature $+25\text{ °C} \pm 15\text{ °C}$;
- pressure site ambient;
- relative humidity 5 % to 95 %.

The standard test conditions shall be used as the default ambient criteria when performing tests. The expanded test conditions are allowed for ambient criteria when performing tests.

NOTE A tightly controlled temperature range is considered unnecessary for most cable tests.

Consideration should be given to the effects of temperature differences and variations on electronic and optical test equipment that may be used in performing the tests. It may be necessary to maintain such equipment at the controlled test conditions by appropriate means.

4.6 Graphical symbols and terminology

See IEC 61931.

4.7 Safety and environmental aspects

All applicable safety and environmental regulations shall be met. Where compliance to ISO/IEC 11801 is required, the information described in IEC/TR 62362 shall be taken into account.

4.8 Calibration

4.8.1 Calibration process

Ensure the apparatus is calibrated and adjusted in accordance with the manufacturer's instructions before use in order to minimize measurement uncertainty.

Record relevant information of the calibration process, such as the calibrated value and uncertainty of the reference material or test equipment used. ISO/IEC Guide 99-12 refers.

4.8.2 Assessment of uncertainties¹

Measurement uncertainty may be defined as the range within which the true value of a measured quantity (the measured) is estimated to lie, within a given likelihood (or confidence level). The measurement uncertainty normally comprises several components, some of which may be estimated using statistical techniques (known as type A uncertainties) whilst others may be estimated on the basis of experience or other information (known as type B uncertainties). Components of uncertainty, or variance, are additive, and a confidence interval may be calculated for the measurements based on the sum of the variance components.

A typical build-up of uncertainty may include the following sources of uncertainty:

- calibration uncertainty of reference materials or equipment used – normally stated on the calibration certificates of the standards;
- transfer uncertainty – estimated changes in the certified values of reference materials or equipment since they were calibrated;
- operational uncertainty – estimated effects of environmental conditions, such as temperature and humidity.
- statistical (random) uncertainty in the measurement of the specimen and the calibration standard – due to, for example, electrical noise, vibration, data quantization, etc.

4.9 Definition of “No change in attenuation”

4.9.1 General

For some of the parameters specified in this standard, the objective is no change in attenuation.

¹ See ISO/IEC Guide 98-3.

These parameters may be affected by measurement uncertainty arising from measurement errors or calibration errors due to a lack of suitable reference standards. Acceptance criteria shall be interpreted with respect to this consideration.

4.9.2 No change in attenuation, single-mode (class B)

The total uncertainty of measurement for this standard shall be $\leq \pm 0,05$ dB for attenuation or $\pm 0,05$ dB/km for attenuation coefficient. Any measured value within this range shall be considered as “no change in attenuation”.

The requirement for these parameters is indicated as “no change ($\leq \pm 0,05$ dB or $\leq \pm 0,05$ dB/km)”.

By agreement between customer and supplier, minor deviation from this limit may be accepted at some low frequency, e.g. less than 10 %. However, for mechanical tests no deviation in excess of 0,15 dB shall be accepted. For environmental tests, no deviation in excess of 0,10 dB/km shall be accepted.

4.9.3 No change in attenuation, multimode (category A1)

The total uncertainty of measurement for this standard shall be $\leq \pm 0,2$ dB for attenuation or $\leq \pm 0,2$ dB/km for attenuation coefficient.

Any measured value within this range shall be considered as “no change in attenuation”.

The requirement for these parameters is indicated as “no change ($\leq \pm 0,2$ dB or $\leq \pm 0,2$ dB/km)”.

By agreement between customer and supplier, minor deviation from this limit may be accepted at some low frequency, e.g. less than 10 %. However for mechanical tests no deviation in excess of 0,5 dB shall be accepted. For environmental tests no deviation in excess of 0,5 dB/km shall be accepted.

4.9.4 No change in attenuation, plastic optical fibre (category A4)

The total uncertainty of measurement for this standard shall be $\leq \pm 2$ % for attenuation.

Any measured value within this range shall be considered as “no change in attenuation”.

The requirement for these parameters is indicated as “No change ($\leq + 2$ %)”.

For mechanical tests no deviation excess of 2 % shall be allowed.

For environmental tests no change, as defined in the relevant specification.

4.9.5 Allowable change in attenuation during mechanical and environmental tests

Depending on fibre type, single-mode or multimode, cable design and application the allowable change criteria might differ.

4.10 Definition of “No change in fibre strain”

4.10.1 General

For some of the parameters specified in this standard, the objective is no change in strain.

These parameters may be affected by measurement uncertainty arising from measurement errors or calibration errors due to a lack of suitable reference standards. Acceptance criteria shall be interpreted with respect to this consideration.

The total uncertainty of measurement for this standard shall be $\pm 0,05$ % (this value to be checked) strain.

Any measured value within this range shall be considered as “no change in strain”.

4.10.2 Allowable change in fibre strain during mechanical and environmental tests

Unless otherwise specified in the detail specification, these values are as follows:

- 20 % of proof strain for long-term loads;
- 60 % of proof strain for short term loads.

4.11 Preconditioning

Most tests are performed at ambient conditions or begin at ambient conditions, per 4.3. The intent is that the preconditioning achieve thermal stability. Unless otherwise specified, precondition samples at ambient conditions for a minimum of 12 h prior to the test.

4.12 Cable load definitions

Long-term load: T_L A load which, for the purposes of the tests herein, represents a load that a cable may be expected to experience over long periods of time, including its entire lifetime. This is the rated maximum load for which a cable is subject in long term tests.

Short-term load: T_S Often called the rated installation load. This is the maximum load for which a cable is rated, i.e. the load that represents the maximum specified load for the cable.

The cable load definitions for aerial cables differ. See IEC 60794-3-20 and IEC 60794-4.

4.13 Recovery time

Recovery time, typically 5 min, is the time allowed for any of the tests before performing the after test measurement.

4.14 Cable qualification test plan

A minimum of one cable per cable design family shall be tested. When testing different sheath configurations within a design family, only the tests that are affected by the design change need to be performed.

In case of changes in cable design, only tests that are affected by the design change need to be performed.

A minimum of 10 fibres from each cable sample shall be measured for attenuation change. Cables with fewer than 10 fibres shall have all fibres tested.

The cable being tested may contain working fibres or may contain working and dummy/scrap fibres. The tested fibres shall be dispersed throughout the working units. For cables with multiple tube designs, non-working tubes or filler rods may be deployed, but they should be used in such a manner that they do not affect the performance of the test. The manufacturer shall position the working units within a cable such that they will be subjected to the full force of the test.