IEC 60794-1-22

Edition 1.0 2012-06

INTERNATIONAL STANDARD

colour inside

Optical fibre cables –
Part 1-22: Generic specification – Basic optical cable test procedures – Environmental test methods

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE U

ICS 33.180.10

ISBN 978-2-83220-131-2

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 60794-1-22 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This edition of IEC 60794-1-22 cancels and replaces the environmental tests 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, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures*
– 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*

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

CDV	Report on voting
86A/1424/CDV	86A/1445/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 60794 series, published 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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

OPTICAL FIBRE CABLES –

Part 1-22: Generic specification – Basic optical cable test procedures – Environmental test methods

1 Scope

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 environmental performance.

Throughout the standard the wording "optical cable" may also include optical fibre units, microduct fibre units, etc.

See IEC 60794-1-2 for general requirements and definitions and reference guide to test methods of all types.

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 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60304, *Standard colours for insulation for low-frequency cables and wires*

IEC 60544-1, *Electrical insulating materials – Determination of the effects of ionizing radiation – Part 1: Radiation interaction and dosimetry*

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

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

IEC 60793-1-54, *Optical fibres – Part 1-54: Measurement methods and test procedures – Gamma irradiation*

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

IEC 60794-1-2, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures*

IEC 60811-502, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 502: Mechanical tests – Shrinkage test for insulations*

IEC 60811-503, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 503: Mechanical tests – Shrinkage test for sheaths*

ISO 4892-2, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 4892-3, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*

3 Method F1 – Temperature cycling

3.1 Object

This measuring method applies to optical fibre cables which are tested by temperature cycling in order to determine the stability behaviour of the attenuation of cables submitted to temperature changes.

Changes in the attenuation of optical fibre cables which may occur with changing temperatures are generally the result of buckling or tensioning of the fibres resulting from differences between their thermal expansion coefficient and the coefficients of the cable strength and sheath members. Test conditions for temperature-dependent measurements shall simulate the worst conditions.

This test can be used either for monitoring cable behaviour in the temperature range which may occur during storage, transportation and usage or to check, in a selected temperature range (usually wider than that required for the above-mentioned case), the stability behaviour of the attenuation connected to a substantially microbend-free situation of the fibre within the cable structure.

NOTE 1 Method F12 is a specialized subset of this method, specifically addressing cables for use in patchcords.

NOTE 2 The ageing test, F9, uses Method F1 as its pre- and post-test temperature cycle. Often these tests are done together.

3.2 Sample

The sample shall be a factory length or a sample of sufficient length as indicated in the detail specification but, nevertheless, of length appropriate to achieve the desired accuracy of attenuation measurements.

In order to gain reproducible values, the cable sample shall be brought into the climatic chamber in a manner such that the deployment does not affect the measurement. Such methods could be a loose coil or on a reel with large diameter coils, cushioned reels with a soft layer or a zero tension facility device.

The ability of the fibre(s) to accommodate differential expansion and contraction (e.g. by slipping within the cable) could be influenced by the bending radius of the cable. Sample conditioning should, therefore, be realized as close as possible to normal usage conditions. The bend diameter of the cable sample shall not violate the minimum bend diameter of the cable, tube or other unit as specified by the detail specification.

Potential problems are due to an actual difference between the expansion coefficients of the test sample and of the holder (e.g. reel, basket, plate) which can induce, during thermal cycles, a significant effect on the test result if "no effect" conditions are not completely fulfilled. The intent is to simulate the installed condition, in which the cable is generally straight for the majority of its length.

Parameters of influence are mainly the details of conditioning, the type and materials of the holder, the diameter of the sample coil or reel.

General recommendations include the following:

a) The winding diameter shall be large enough to keep the ability of the fibre to accommodate differential expansion and contraction. A winding diameter substantially greater than the value selected for cable delivery may be necessary.

b) Any risk of cable expansion (or contraction) limitation created by conditioning shall be suppressed. In particular, special care should be taken to avoid residual tension on the cable during the test. For example, a tight winding on a drum is not recommended as it can limit cable contraction at low temperature. On the other hand, a tight multilayer winding can limit expansion at high temperature.

c) The use of loose winding is recommended with large diameter coils and cushioned reels with a soft layer or zero tension facility device.

d) The number of fibres tested shall conform to IEC 60794-1-1:2011, Annex B.

e) The fixed cable ends as well as connection to the equipment shall be outside of the temperature chamber to avoid negative influences.

When necessary, in order to limit the length of the cable under test, it is permissible to concatenate several fibres of the cable and to measure the concatenated fibres. The number of connections shall be limited and they should be located outside the climatic chamber.

3.3 Apparatus

The apparatus consists of:

a) an appropriate attenuation measuring apparatus for the determination of attenuation change (see the test methods of IEC 60793-1-40);

b) a climatic chamber of a suitable size to accommodate the sample and whose temperature shall be controllable to remain within ± 3 °C of the specified testing temperature. One example of a suitable chamber is given in Clause 8 of IEC 60068-2-14:2009: Test Nb: Change of temperature with specified rate of change;

c) a temperature sensing device to measure the temperature of the sample, when applicable. Samples with a large thermal mass may require measurement to verify temperature stability rather than utilizing a specified exposure period, t_1.

3.4 Procedure

3.4.1 Initial measurement

The sample shall be visually inspected and a basic value for attenuation at the initial temperature shall be determined.

3.4.2 Pre-conditioning

Pre-conditioning conditions shall be agreed between customer and supplier.

3.4.3 Conditioning

Figures 1 and 2 show, graphically, the initial cycle(s) and the final cycle. Together, they illustrate the temperature cycle sequence to be used. If only one cycle is specified, use Figure 1.

(1) The sample at ambient temperature shall be introduced into the climatic chamber which is also at that temperature.

(2) The temperature in the chamber shall then be lowered to the appropriate low temperature T_{A2} at the appropriate rate of cooling.

(3) After temperature stability in the chamber has been reached the sample shall be exposed to the low temperature conditions for the appropriate period t_1.

(4) A minimum soak time is given in Table 1; however the soak time must be sufficient to bring the complete cable to equilibrium with the specified temperature.

(5) The temperature in the chamber shall then be raised to the appropriate high temperature T_{B2} at the appropriate rate of heating.

(6) After temperature stability in the chamber has been reached, the sample shall be exposed to the high temperature conditions for the appropriate period t_1.

(7) The temperature in the chamber shall then be lowered to the value of the ambient temperature at the appropriate rate of cooling. This procedure constitutes one cycle (see Figure 1 or 2). If this is the intermediate step in a series of cycles, no soak is required, but no measurements shall be taken.

(8) Continue to the next cycle, using steps 2) through 7). The sample shall be subjected to at least two cycles unless otherwise required by the relevant detail specification. The initial cycle(s) shall comprise one low temperature and one high temperature, per Figure 1. The last cycle shall comprise one or more low temperatures and one or more high temperatures, per Figure 2, as required by the relevant detail specification. On the last cycle, if multiple temperatures are specified, the sample shall be held at each intermediate temperature (T_{A1} or T_{B1}) for the appropriate time t_1. At the end of the cycling sequence, hold the sample at ambient temperature for the appropriate period t_1.

(9) The attenuation shall be measured at ambient temperature at the start of the first cycle, at the end of the soak time t_1 at each of the specified temperature steps (T_{A1}, T_{A2}, T_{B1}, T_{B2}) in the last cycle, and at ambient temperature at the end of the last cycle.

(10) Before removal from the chamber, the sample under test shall have reached temperature stability at ambient temperature.

Table 1 – Minimum soak time t_1

Minimum soak times for a given sample mass	
Sample mass kg	**Minimum soak time, t_1** h
Under 0,35	0,5
0,36 to 0,7	1
0,8 to 1,5	2
1,6 to 15	4
16 to 100	8
101 to 250	12
251 to 500	14
Over 501	16

NOTE It is the responsibility of the tester to assure that the soak time is long enough to bring the cable to equilibrium with the specified temperature.