SLOVENSKI STANDARD
oSIST prEN IEC 60794-1-201:2023

01-maj-2023

Optični kabli - 1-201. del: Splošna specifikacija - Osnovni preskusni postopki za optične kable - Ciklične temperaturne spremembe, metoda F1

Optical fibre cables - Part 1-201: Generic specification - Basic optical cable test procedures - Temperature cycling, Method F1

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COMMITTEE DRAFT FOR VOTE (CDV)

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IEC SC 86A : FIBRES AND CABLES	
SECRETARIAT: France	SECRETARY: Mr Laurent Gasca
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	
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- any relevant patent rights of which they are aware and to provide supporting documentation,
- any relevant “in some countries” clauses to be included should this proposal proceed. Recipients are reminded that the enquiry stage is the final stage for submitting "in some countries" clauses. See AC/22/2007.

TITLE:

Optical fibre cables - Part 1-201: Generic specification - Basic optical cable test procedures - Temperature cycling, Method F1

PROPOSED STABILITY DATE: 2026

NOTE FROM TC/SC OFFICERS:

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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OPTICAL FIBRE CABLES –

Part 1-201: Generic specification – Basic optical cable test procedures – Temperature cycling, method F1

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International Standard IEC 60794-1-201 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This first edition of IEC 60794-1-201 cancels and replaces Method F1 of the second edition of IEC 60794-1-22: 2017. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) remove all references to the temperature sensing device and replace with note "for further study";
b) separate the conditioning procedure into Procedure 1 and Procedure 2 to avoid confusion;
c) define the ambient temperature test condition as per IEC 60794-1-2;
d) decrease the minimum soak time for sample mass larger than 16 kg in table 1.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

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

The French version of this standard has not been voted upon.

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

A list of all 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 document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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

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OPTICAL FIBRE CABLES –

Part 1-201: Generic specification – Basic optical cable test procedures – Temperature cycling, method F1

1 Scope

This part of IEC 60794-1 defines test procedures to be used in establishing uniform requirements for the environmental performance of

- optical fibre cables for use with telecommunication equipment and devices employing similar techniques, and
- cables having a combination of both optical fibres and electrical conductors.

Throughout this document, the wording "optical cable" can also include optical fibre units, microduct fibre units, etc.

This document defines a test standard to determine the ability of a cable to withstand the effects of temperature cycling by observing changes in attenuation.

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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 60793-1-46, *Optical fibres – Part 1-46: Measurement methods and test procedures – Monitoring of changes in optical transmittance*

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 – General guidance*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

4 Method F1 – Temperature cycling

4.1 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. This method can also be used for evaluation of buffer tubes or other elements independent of a cable construction, as defined by a detail specification.

Changes in the attenuation of optical fibre cables, which can occur with changing temperature, 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 can occur during storage, transportation and usage, or to check, in a selected temperature range (usually wider than that required for the above-mentioned cases), the stability behaviour of the attenuation connected to a substantially microbend-free situation of the fibre within the cable structure.

NOTE 1 Method F12 in IEC 60794-1-212 is similar to this method, but with cable elements fixed at both sample ends. Method F12 assesses the attenuation behaviour of a cable without end movement intended for termination with, for example, interconnecting devices or passive components.

NOTE 2 The ageing test, method F9 in IEC 60794-1-209, uses method F1 as its pre- and post-test temperature cycle. Often these tests are performed together.

NOTE 3 The cable shrinkage test, method F17 in IEC 60794-1-217, uses method F1 as temperature cycling. These tests can be done together.

4.2 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. The sample is additionally defined as the cable sample as deployed for testing.

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, and 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 can 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.

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.

4.3 Apparatus

The apparatus shall consist of the following.

a) An appropriate attenuation measuring apparatus for the determination of attenuation change (see the test methods of IEC 60793-1-46).

b) a climatic chamber of a suitable size to accommodate the sample 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.

4.4 Procedure

4.4.1 Preconditioning

The sample shall be preconditioned at standard ambient temperature conditions as defined in IEC 60794-1-2.

4.4.2 Initial measurement

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

4.4.3 Conditioning

Procedure 1

If only one high and low temperature is specified in the detail specification, then procedure 1 is applicable. Figure 1 shall be used for the initial cycle(s) and the final cycle during the test. Throughout this procedure, the ambient temperature condition is the standard test condition as defined in IEC 60794-1-2.

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 a rate of cooling not to exceed 60 ºC per hour, unless otherwise specified.

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 (see (4), below).

4) A minimum soak time is given in Table 1; however, the soak time, t_1, shall be sufficient to bring the complete cable to equilibrium with the specified temperature.

NOTE Cable temperature sensing device to measure the temperature of the cable sample is for further study.

5) The temperature in the chamber shall then be raised to the appropriate high temperature T_{B2} at a rate of heating not to exceed 60 ºC per hour, unless otherwise specified.

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. If this is the intermediate step in a series of cycles, no soak is required, and no measurements shall be taken.

8) Continue to the next cycles, using steps 2) through 7). The sample shall be subjected to at least two cycles unless otherwise required by the relevant detail specification. At the end of the cycling sequence, hold the sample at ambient temperature for the appropriate period t_1.

9) The change in 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_{A2}, T_{B2}) in the final cycle, and at ambient temperature at the end of the final cycle. If measurement at

intermediate cycles is required by the detail specification, the measurements shall be performed in the same manner.

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

Procedure 2

If multiple (two or more) low or high temperatures are specified in the detail specification, then procedure 2 is applicable. Figure 1 shall be used for the initial cycle(s) except for the final cycle and Figure 2 shall be used for the final cycle during the test. Throughout this procedure, the ambient temperature condition is the standard test condition as defined in IEC 60794-1-2.

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

2) Using steps 2) through 7) of Produce 1 for the initial cycle(s) (except for the final cycle).

NOTE T_{A2} here is the extreme low temperature among multiple low temperatures and T_{B2} here is the extreme high temperature among multiple high temperatures.

3) During the last cycle, the sample shall be held at each intermediate temperature (T_{A1} or T_{B1}) and each extreme temperature (T_{A2} or T_{B2}) for the appropriate time t_1 as per Figure 2. At the end of the cycling sequence, hold the sample at ambient temperature for the appropriate period t_1.

4) The sample shall be subjected to at least totally two cycles unless otherwise required by the relevant detail specification. The change in 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 final cycle, and at ambient temperature at the end of the final cycle. If measurement at intermediate cycles is required by the detail specification, the measurements shall be performed in the same manner.

5) 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 (weight of cable under test)	
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 100	4
101 to 250	6
251 to 500	8
Over 501	12
NOTE 1 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. NOTE 2 If more than one sample is put into the chamber, the largest sample mass of all single samples should be compared with the values in the table for the determination of the minimum soak time.	