IEC 60794-1-21

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INTERNATIONAL STANDARD

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AMENDMENT 1
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Optical fibre cables – Part 1-21: Generic specification – Basic optical cable test procedures – Mechanical test methods

Câbles à fibres optiques – Partie 1-21: Spécification générique – Procédures fondamentales d'essais des câbles optiques – Méthodes d'essai mécanique

IEC 60794-1-21:2015-03/AMD1:2020-03(en-fr)

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FOREWORD

This amendment has been prepared by subcommittee SC 86A: Fibre optics, of IEC technical committee TC 86: Fibres and cables.

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

FDIS	Report on voting
86A/1975/FDIS	86A/1990/RVD

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

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

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INTRODUCTION to Amendment

This Amendment adds new test methods and revises existing ones in a timely fashion until the next full revision of IEC 60794-1-21:2015.

Both the E-series numbering of the test methods, clause numbers, figures and equations of the technical section are aligned with IEC 60794-1-21:2015.

As part of the ongoing rationalization of the test methods specification set, several tests of IEC 60794-1-21 were determined to be more properly aligned with others of the set and have been moved. To that end, the proposed text to affect these moves has been inserted in this document.

Clause 7 has been redesignated as a cable element test method. It has been moved to IEC 60794-1-23 Ed2 and given the test method number G10A.

Clause 8 has been redesignated as a cable element test method. It has been moved to IEC 60794-1-23 Ed2 and given the test method number G10B.

Clause 18 has been redesignated as an environmental test method. It has been moved to IEC 60794-1-22 Ed2 and given the test method number F16.

Clause 19 has been redesignated as a cable element test method. It has been moved to IEC 60794-1-23 Ed2 and given the test method number G9.

1 Scope and object

Replace the existing last paragraph by the following new paragraph:

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

7 Method E5A: Stripping force stability of cabled optical fibres

Delete the entire clause, including its title.

8 Method E5B: Strippability of optical fibre ribbons

Delete the entire clause, including its title.

18 Method E14: Compound flow (drip)

Delete the entire clause, including its title.

19 Method E15: Bleeding and evaporation

Delete the entire clause, including its title.

32 Method E27: Indoor simulated installation test

Replace the existing text by the following new text:

32.1 Object

This test is designed to simulate an installation of an indoor cable where tight corners, attachment points and cable storage may occur. This test is intended to demonstrate a level of robustness of the cable tested which is more severe than traditional installation practices.

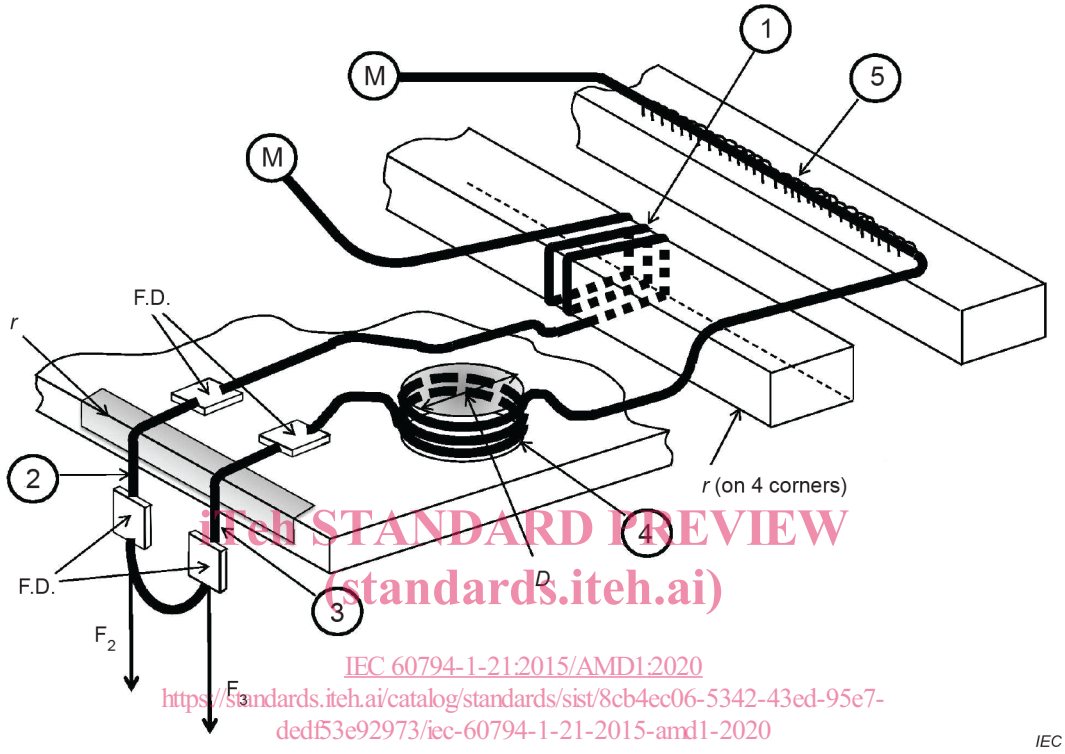
NOTE This test is primarily intended to evaluate the performance of cables containing bending loss insensitive fibres. Indoor cables containing other fibre types are not assumed to fulfil the requirements associated with this test.

32.2 Sample

The cable sample shall be of sufficient length to accommodate the route necessary to accomplish the steps of the procedure defined in 32.4 and to allow the specified optical testing. A minimum length of 100 m is recommended.

32.3 Apparatus

The apparatus shall be made of a material as specified in the detail specification. In general, the apparatus is a building wall "stud" or other substrate of sufficient length to accommodate the required wraps and attachment points. The test fixtures (see Figures 34 and 36) are intended to simulate installation around a door or a window as well as cable that skirts around obstacles using staples or other attachment methods as specified.



Key

Test sequence number

1 multiple corner bends

2 corner bend, 2 kg load

3 corner bend, residual load

4 mandrel wrap

5 attachments, serial

M optical measurement

F.D. cable fixing device, as in method E28, for example

r 1 mm corner radius

D 10 mm mandrel diameter

F_2 2 kg load

F_3 residual load for cable specified

The test sequences correspond to the numbered items of 32.4.

Figure 34 – Indoor installation simulation apparatus

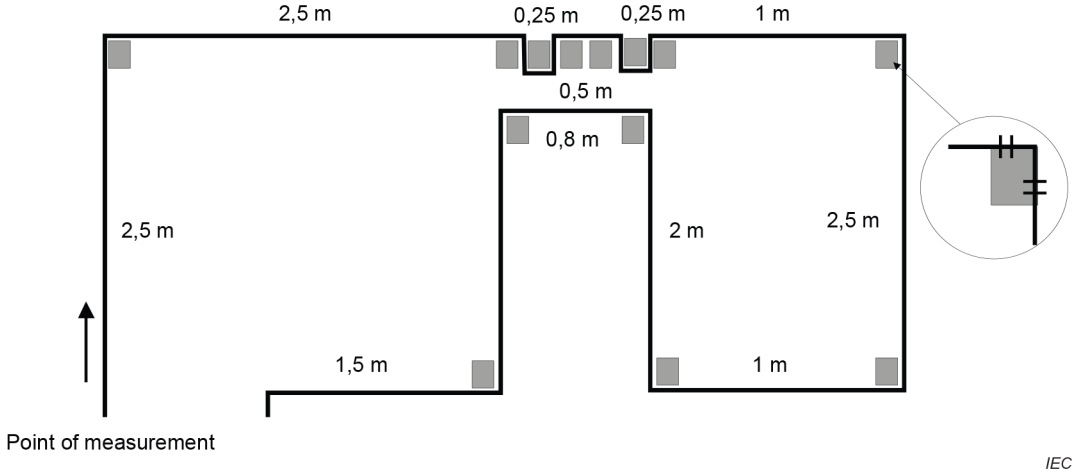


Figure 36 – Stapling and bending test fixture

The apparatus of Figure 36 may be used for the multiple corner bends section (1) and the serial attachment section (5) of Figure 34 with results that are comparable.

NOTE The material and attachment methods are significantly affected by local building practices. Many areas use a wooden stud; steel, composite materials, etc. are also common.

32.4 Procedure

A continuous length of cable shall progress through each of the following conditions. See Figure 34.

1) Fourteen or fifteen 90° corner bends (1 mm radius), as appropriate for the fixture, with minimal manual tension, sufficient to wrap the cable around the fixture.

   Use of a wood device for corner bends can result in indentation in the device that could produce incorrect bending and test results. The use of metallic materials for the device or for the corners is recommended.

   NOTE The specified bend radius is that of the apparatus corner. The cable is not presumed to assume the 1 mm radius bend. The structure of a cable under load, as specified, will result in a cable bend radius that is characteristic of the cable structure, thus determining whether said cable can operate when bent around the corners and mandrel of the specified apparatus.

2) One 90° corner bend (1 mm radius) with a 2 kg load.
3) One 90° corner bend (1 mm radius) with rated residual load.
4) Two 10 mm diameter mandrel wraps.
5) Thirty attachment points, as specified in the detail specification.

   Many fastening methods for cables can be considered, including appropriate staples, adhesives, and cable ties. Methods shall be compatible with the substrate used and local practices.

   In the case of stapling, only crowned (round) staples of dimensions compatible with the size of the cable are allowed. Staple according to the state of the art. Follow the procedures recommended by the manufacturer.

6) Test the cable for a period of time sufficient for any attenuation change to become stable.

32.5 Requirements

The acceptance criteria for the test shall be stated in the detail specification. Typical failure modes include damage to the cable or cable elements, residual degradation of optical performance beyond the specified level, or loss of continuity.

It is recommended that the attenuation due to the stapling should not be greater than

– 0,20 dB at 1 550 nm for single-mode fibre, or
– 0,40 dB at 1 300 nm for multimode fibre.

32.6 Details to be specified

The following shall be specified in the detail specification:

– cable type to be tested;
– type of substrate;
– number of 90° corner bends under minimal manual tension, if different from 32.4;
– number of 90° corner bends under load, if different from 32.4;
– the radius of the sharp corner, if different from 32.4;
– type of attachment; method and distance separating the attachment points, if required;
– tension for 32.4, 2), if different from 32.4;
– cable rated residual load;
– test temperature;
– acceptance criteria (see 32.5).

Add, after the existing Clause 33, the following new clauses:

34 Method E29: Straight midspan access to optical elements

34.1 Object

This test is to evaluate if a core optical element can be effectively removed from a cable by midspan access. A substantially straight cable being tested is subjected to two types of controlled minor bends for the test. This test is intended to evaluate a cable type which is designed for easy withdrawal of cable elements, midspan, for external connection, as in MDU retractable cable.

NOTE The optical elements can be a fibre, a cord, a ribbon, a micro-module, or other, as appropriate.

34.2 Apparatus

An apparatus shall be constructed to test a cable according to either procedure 1 or procedure 2 described in 34.4.2 and 34.4.3 respectively. The apparatus shall conform to the conceptual description of the test below, using the variations described in procedures 1 and 2.

The concept of the test is as follows (refer to Figure 37).

– A part of the cable sheath is removed (window 2) to have access to the optical elements.
– Depending on need, one or several elements are cut in window 2.
– A second window (window 1) is made on the cable.
– Elements cut in window 2 can be removed from window 1.

Figure 37 – Concept of straight midspan access

The apparatus shall consist of the following.

– Positions for opening windows 1 and 2 (Figure 37), with space between. The space shall be 6 m, unless otherwise specified.
– Fixturing between the window positions to route the cable as specified:
  - straight, per Figure 37, if required;
  - two controlled bends, per Figure 38 a) and 38 b); and
  - one S-bend, per Figure 39.
– Appropriate clamping fixtures to secure the cable for the test without compressing the cable or imparting increased attenuation.

34.3 Sample

A single cable sample, 50 m in length, shall be used. Alternatively, two samples from like cables, each 20 m, may be used. Other lengths may be used, as specified.

34.4 Procedure

34.4.1 General

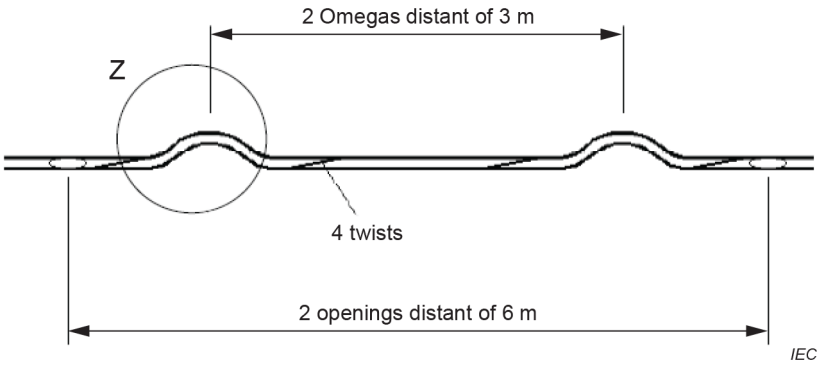
The manufacturer shall propose methods and tools to open windows of 80 mm length in the cable without risk to damage elements or fibres. The manufacturer shall propose methods to avoid risk of tight bends (below the minimum bend radius) or kinking of elements during the removal from the cable.

Remove a length of one of two adjacent elements (microbundle or buffer) using one or both of the two procedures below, as specified.

The attenuation of cable elements not removed shall be monitored during the test. The number of fibres monitored shall be specified by the detail specification.

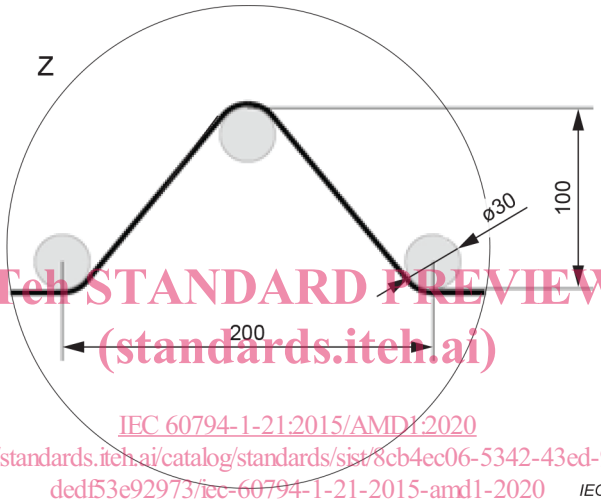
34.4.2 Procedure 1

– A section of a cable sample, approximately 15 m from an end, shall be laid according to the configurations described in Figure 37, having two bends, preferentially in a vertical position. The size and locations of the bends shall meet the following criteria:
  - ≥ 4 core lay length twists between the bends (Figure 38 a));
  - 2 bends produced using the criteria below, per Figure 38 b), and separated by 3 m (Figure 38 a)):
    i) 3 mandrels: 30 mm in diameter;
    ii) depth: 100 mm;
    iii) length: 200 mm.



a) Location of bends

Dimensions in millimetres



b) Details of bend

Figure 38 – Straight midspan access – Procedure 1

– Block elements of the cable at each end of the cable, beyond the window locations, by folding them or coiling the cable.
– Monitor the attenuation of the non-removed elements, as specified.
– Open two windows, separated by 6 m, according to the manufacturer's method, to provide access to elements. Verify the integrity of the elements after this operation.
– Cut two adjacent elements at window 2.
– From window 1, remove one of the two elements, according to the manufacturer's procedure.
  - Measure the tensile stress needed with a dynamometer, if required.
  - Measure any displacement of the other cut element.

34.4.3 Procedure 2

At a position in the sample approximately 15 m from the site of procedure 1, make two windows, separated by 6 m, as in Procedure 1. Block the fibres at the ends, as in procedure 1.

Between these two windows, make two right angles, bent at the minimum bend radius of the cable under test. The two bends shall be immediately adjacent to each other. See Figure 39.

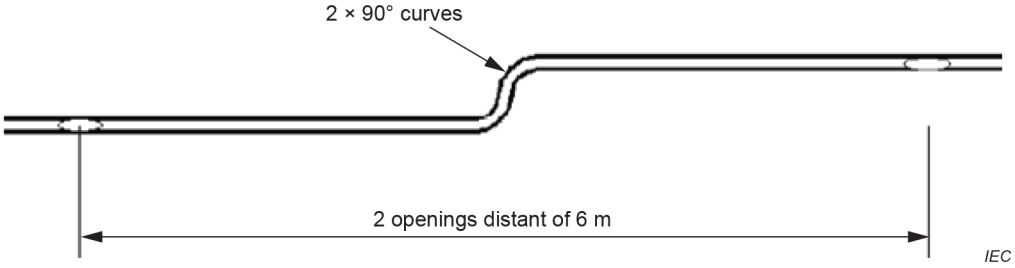


Figure 39 – Straight midspan access – Procedure 2

Perform procedure 2 in the same manner as the procedure 1. The key functional parts of the procedure are the following.

– Cut two adjoining elements in window 1.
– Remove one element from window 2.
  • Measure the tensile stress needed to remove it, if required.
  • Measure the displacement of the other cut element.

34.4.4 Overview

Accomplish procedures 1 and 2 successively. At the end of each procedure, visually examine the removed and non-removed elements and any fibres within to assess any abrasion of fibre and elements.

34.5 Requirements

Acceptance criteria in the detail specification may include

– no abrasion or perforation of the elements or fibres,
– no broken fibres in either the removed or non-removed elements,
– maximum allowed attenuation increase,
– maximum allowed sliding distance of the non-removed element, and
– maximum allowed tensile stress.

34.6 Details to be specified

The following shall be specified in the detail specification:

– cable type to be tested;
– if the tensile stress to remove the elements is to be measured;
– the maximum tensile stress to remove an element, if required.

35 Method E30: Coefficient of friction between cables

35.1 Object

The object of this test is to ensure that the coefficient of friction of the sheathing material of a specified cable against another specified cable is less than the value specified. Coefficient of friction between two cables is an important parameter for installation of a cable in a duct or tray having previously installed cable.

35.2 Sample

Two cables, which may be of the same type and size, or different, as specified, are selected. The first cable shall be of sufficient length to make 2, or more (as specified), turns on the test sheave. The second cable shall be of sufficient length of make 1/2 turn about the test sheave holding the first cable, plus length sufficient for pulling and for attaching the pulling apparatus and the snubbing force apparatus on the ends.

35.3 Apparatus

The apparatus, illustrated in Figure 40, shall consist of the following.

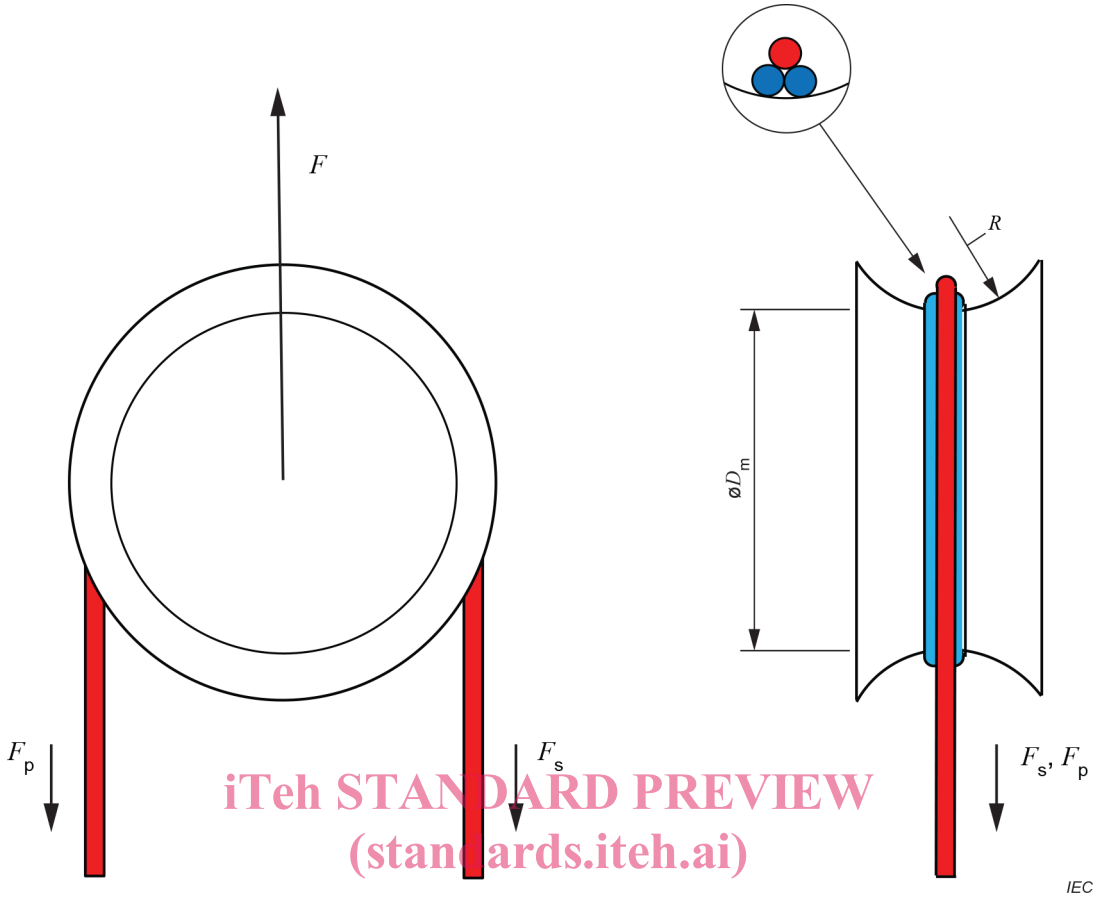
– A sheave: the sheave root diameter, D_m, shall be 20 to 25 times the second cable diameter (but not less than the minimum bend diameter of that cable), with a circular groove formed by a radius, R, of a minimum of 5 times the second cable diameter.

  For cables that are not round, use the minimum dimension.

– A weight for attachment to one end of the second cable, sufficient to apply a snubbing force tension so that the second cable contours the sheave: 1 N is generally sufficient, or it may be as specified.

– An apparatus to apply a pulling force to one end of the second cable.

– A tensile measuring apparatus attached to the sheave.



Key

F_s snubbing force, generally a weight, sufficient to make cable contour the sheave

F_p pulling force, sufficient to move the cable, but not specified or measured

F measured reaction force on the mandrel

D_m sheave root diameter, 20 to 25 × d, or as specified

R sheave face radius, min. 5 × d, or as specified

Figure 40 – Coefficient of friction test apparatus (drum test)

35.4 Procedure

– Wind the first cable sample on the sheave using 2, or more (as specified), adjacent turns. Fix this coil in place.

– Wind the second cable sample in a half-turn on top of the coil. Alternatively, for thin cords, wind the second cable sample in a quarter-turn on top of the coil.

– Apply a snubbing force (weight in 35.3), F_S, to one end of the second cable and a tensile pulling force, F_P, to the other end of that sample, so as to move it on to the coil at a constant speed of 3 mm/min. The force F_P is not measured.

– Using the tensile measuring apparatus, measure the reaction force, F, on the sheave while the second cable is moving. The value of F used in Equation (17) and Equation (18) shall be the average of the peak forces observed during the test.

– Calculate the coefficient of friction using Equation (17) for the half-turn case or Equation (18) for the quarter-turn case.