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SERIES L: CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Optical fibre cables for aerial application

ITU-T Recommendation L.26

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Optical fibre cables for aerial application

Summary

This Recommendation describes characteristics, construction and test methods of optical fibre cables for aerial application but does not apply to Optical Fibre Ground Wire (OPGW) cables. First, in order that an optical fibre demonstrates sufficient performance, characteristics that a cable should possess are described. Then, the method of examining whether the cable has the required characteristic is described. Required conditions may differ according to installation environment. Therefore, detailed conditions of experiments need to be agreed between a user and a supplier on the basis of the environment where a cable is used.

Source

ITU-T Recommendation L.26 was revised by ITU-T Study Group 6 (2001-2004) and approved under the WTSA Resolution 1 procedure on 22 December 2002.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Optical fibre cables for aerial application

1 Scope

This Recommendation:

– refers to single-mode optical fibre cables to be used for telecommunication networks in aerial installations of outside plant;

– deals with mechanical and environmental characteristics of the aerial optical fibre cable (self-supporting cable and non self-supporting cable).

  The optical fibre dimensional and transmission characteristics, together with their test methods, should comply with ITU-T Recs G.651, G.652, G.653, G.654 and G.655 which deal with a multi-mode graded index optical fibre and single-mode optical fibres;

– deals with fundamental considerations related to optical fibre cable from the mechanical and environmental points of view;

– acknowledges that some optical fibre cables may contain metallic elements, for which reference should be made to the ITU-T Handbook, *Outside Plant Technologies for Public Networks* (see ITU-T Rec. L.1), and other L-series and K-series (e.g., ITU-T Rec. K.25) Recommendations;

– deals with water-blocked cables employing compound filling and/or water-swellable materials;

– considers that fibres are spliced together or connected using connectors.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

2.1 Normative references

[1] ITU-T Recommendation G.650.1 (2002), *Definitions and test methods for linear, deterministic attributes of single-mode fibre and cable*.

[2] ITU-T Recommendation G.650.2 (2002), *Definitions and test methods for statistical and non-linear attributes of single-mode fibre and cable*.

[3] ITU-T Recommendation G.651 (1998), *Characteristics of a 50/125 µm multimode graded index optical fibre cable*.

[4] ITU-T Recommendation G.652 (2000), *Characteristics of a single-mode optical fibre cable*.

[5] ITU-T Recommendation G.653 (2000), *Characteristics of a dispersion-shifted single-mode optical fibre cable*.

[6] ITU-T Recommendation G.654 (2002), *Characteristics of a cut-off shifted single-mode optical fibre and cable*.

[7] ITU-T Recommendation G.655 (2000), *Characteristics of a non-zero dispersion-shifted single-mode optical fibre cable*.

[8] ITU-T Recommendation K.25 (2000), *Protection of optical fibre cables*.

[9] ITU-T Recommendation K.29 (1992), *Coordinated protection schemes for telecommunication cables below ground*.

[10] ITU-T Recommendation K.47 (2000), *Protection of telecommunication lines using metallic conductors against direct lightning discharges*.

[11] ITU-T Recommendation L.1 (1988), *Construction, installation and protection of telecommunication cables in public networks.*

[12] ITU-T Recommendation L.46 (2000), *Protection of telecommunication cables and plant from biological attack*.

[13] IEC 60793-1:2001, *Optical fibres – Part 1: Measurement methods and test procedures*.

[14] IEC 60793-2:2001, *Optical fibres – Part 2: Product specifications*.

[15] IEC 60794-1-1:2001, *Optical fibre cables – Part 1-1: Generic specification – General*.

[16] IEC 60794-1-2:1999, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures*.

[17] IEC 60794-3:2001, *Optical fibre cables – Part 3: Sectional specification – Outdoor cables*.

2.2 Informative references

[1] ITU-T Recommendation L.1 (1988), *Construction, installation and protection of telecommunication cables in public networks*.

[2] ITU-T Recommendation L.10 (2002), *Optical fibre cables for duct and tunnel application*.

[3] IEC 60708-1:1981, *Low-frequency cables with polyolefin insulation and moisture barrier polyolefin sheath. Part I: General design details and requirements*.

[4] ITU-T Recommendation L.43 (2002), *Optical fibre cables for buried application*.

3 Terms and definitions

For the purpose of this Recommendation, the definitions given in ITU-T Recs G.650.1, G.650.2 and G.651 apply.

3.1 All Dielectric Self-Supporting (ADSS): in which the tensile element is provided by a non-metallic reinforcement (e.g., aramid yarns, glass-fibre-reinforced materials or equivalent dielectric strength members) placed under or within the plastic sheath; the outer shape is circular.

3.2 Self-Supporting (SS) cable: cables in which the sheath includes a metallic or non-metallic bearing element, to form a figure "8".

3.3 lashed cable: non-metallic cables installed on a separate suspension catenary and held in position with a binder cord or special preformed spiral clips.

3.4 Maximum Allowable Tension (MAT): the maximum tensile load that may be applied to the cable without detriment to the tensile performance requirement (optical performance, fibre strain).

3.5 Rated Tensile Strength (RTS): summation of the product of nominal cross-sectional area, minimum tensile strength and stranding factor for each load-bearing material in the cable construction.

3.6 strain margin: the strain margin is defined as the amount of strain the cable can sustain without strain on the fibres due to cable elongation.

3.7 differential movement of cable components: the relative movement of various elements of the cable to one and another. This movement can either be reversible or irreversible. It can be induced by temperature or tension variation. An example of this is "fibre grow-out", in which individual fibres begin to protrude from the end of the cable sheath.

4 Abbreviations

This Recommendation uses the following abbreviations:

SZ Reverse oscillating stranding

UV Ultraviolet ray

5 Characteristics of optical fibres and cables

5.1 Optical fibre characteristics

Optical fibres as described in ITU-T Recs G.651, G.652, G.653, G.654 or G.655 should be used.

5.1.1 Transmission characteristics

The typical transmission characteristics for each optical fibre are described in its respective Recommendation. Unless specified otherwise by the users of the Recommendation, those values apply to the corresponding cabled optical fibre.

5.1.2 Fibre microbending

Severe bending of an optical fibre involving local axial displacement of a few micrometres over short distances caused by localized lateral forces along its length is called microbending. This may be caused by manufacturing and installation strains and also dimensional variations of cable materials due to temperature changes during operation.

Microbending can cause an increase in optical loss. In order to reduce microbending loss, stress randomly applied to a fibre along its axis should be eliminated during the fibre's incorporation into the cable, as well as during and after cable installation.

5.1.3 Fibre macrobending

Macrobending is the resulting curvature of an optical fibre, which is large relative to the fibre diameter, after cable manufacture and installation.

Macrobending can cause an increase in optical loss. The optical loss increases inversely to the bending radius of the fibre; the macrobending should not be severe enough to significantly increase the optical loss.

5.2 Mechanical characteristics

5.2.1 Bending

Under the dynamic conditions encountered during installation, the fibre may be subjected to strain from both cable tension and bending. The strength elements in the cable and the installation bend radii should be selected to limit this combined dynamic strain below the specified maximum allowable fibre strain in order that the predicated lifetime of the fibre is not reduced.

The fibre bending radii remaining after cable installation shall be large enough not to present macrobending loss.

5.2.2 Tensile strength

Optical fibre cable is subjected to short-term loading during manufacture and installation, and may be affected by continuous static loading and/or cyclic loading during operation (e.g., temperature variation). Continuous loading up to the cable limits may be present during the full lifetime of the cable. Fibre strain may be caused by tension, torsion, bending and creep occurring in connection with cable weight, cable installation and/or type of aerial installation and/or environmental conditions such as a wind and/or ice and/or temperature. Changes in the tension of the cable due to the variety of factors encountered during the service life of the cable can cause the differential movement of the cable components. This effect needs to be considered in the cable design.

In order to design tensile characteristics, Maximum Allowable Tension, Rated Tensile Strength and strain margin should be considered.

NOTE – Where a cable is subjected to permanent loading during its operational life, the fibre preferably should not experience additional strain.

5.2.3 Crush and impact

The cable may be subjected to crush and impact both during installation and operational life.

The crush and impact may increase the optical loss (permanently or for the time of application of the stress) and excessive stress may lead to fibre fracture.

Self-supporting cable structure should be able to withstand the compression effects without additional optical loss.

5.2.4 Torsion

Under dynamic conditions encountered during installation and operation, the cable may be subjected to torsion, resulting in residual strain of the fibres and/or damage of the sheath. If this is the case, the design of cable should allow a specified number of cable twists per unit length without an increase in fibre loss and/or damage to the sheath. The maximum residual fibre strains expected, caused by torsion, tension and bending, should be used to specify the long-term strain limit of the fibre.

5.3 Environmental conditions

5.3.1 Hydrogen gas

In the presence of moisture and metallic elements, hydrogen gas may be generated. Hydrogen gas may diffuse into silica glass and increase optical loss. It is recommended that the hydrogen concentration in the cable, as a result of its component parts, should be low enough to ensure that the long-term effects on the increase of optical loss are acceptable. The method for estimating the concentration of hydrogen in optical cables is given by ITU-T Rec. L.27.

Further information can be found in IEC 60794-1-1, Annex D.

5.3.2 Moisture permeation

In the case of aerial application, normally moisture does not represent a significant issue.

5.3.3 Water penetration

In the event of damage to the cable sheath or to a splice closure, longitudinal penetration of water in a cable core or between sheaths can occur. The penetration of water causes an effect similar to that of moisture. The longitudinal penetration of water should be minimized or, if possible, prevented. In order to prevent longitudinal water penetration within the cable, techniques such as filling the cable core completely with a compound or with discrete water blocks or swellable components (e.g., tapes, roving,…) are used. In the case of unfilled cables, dry-gas pressurization can be used. Water in the cable may be frozen under some conditions and can cause fibre crushing with a resultant increase in optical loss and possible fibre breakage.

5.3.4 Lightning

Fibre cables containing metallic elements such as conventional copper pairs or metal sheaths are susceptible to lightning strikes.

To prevent or minimize lightning damage, consideration should be given to ITU-T Recs K.25, K.29 and K.47.

A fully dielectric cable can minimize the hazardous damage from lightning.

5.3.5 Biotic damage

The small size of an optical fibre cable makes it more vulnerable to rodent, bird and insect attack. Where rodents cannot be excluded, metallic or special non-metallic protection should be provided. Further information is described in ITU-T Rec. L.46, "Protection of telecommunication cables and plant from biological attack".

5.3.6 Vibration

Overhead cable vibrations are produced either by laminar wind stream causing curls at the lee side of the cable (aeolian vibration) or by variations in wind direction relative to the cable axis (galloping effect). A well-established surveillance routine will identify the activity in order to make a careful choice of the route and to decide installation techniques and/or the use of vibration control devices to minimize this type of problem.

5.3.7 Temperature variations

During storage, installation and operation, cables may be subjected to several temperature variations. Generally, aerial cables are more exposed to significant temperature variation than underground cables. Therefore, this issue is very important. Expansion of the cable due to a variation in temperature to a high level may cause a significant reduction of the safe clearance to ground. Shrinkage of the cable due to a variation in temperature to a low level may cause the maximum working tension to be reached. Under these conditions, the variation of attenuation of the fibres shall be reversible and shall not exceed the specified limits.

5.3.8 Wind

The fibre strain may be caused by tension, torsion and vibration occurring in connection with wind pressure. Induced dynamic and residual strain in the fibre may cause fibre breakage if the specified long-term strain limit of the fibre is exceeded.

To reduce any fibre strain induced by wind pressure, the strength member should be selected to limit this strain to safe levels, and the cable construction may mechanically decouple the fibre from the sheath to minimize the strain. Alternatively, to reduce fibre strain, the cable may be lashed to a high-strength support strand.

In aerial installations, winds will cause vibrations and, in figure-of-eight and suspension wire installations, galloping of the entire span of the cable may occur. In these situations, cables should be designed and/or installed to provide stability of the transmission characteristics and mechanical performance. Cable installations should be designed to minimize the influence of wind.

5.3.9 Snow and ice

The fibre strain may be caused by tension occurring in connection with snow loading and/or ice formation around the cable. Induced fibre strain may cause excess optical loss and may cause fibre breakage if the specified long-term strain limit of the fibre is exceeded.

Dynamic strain in the fibre may be induced by vibration caused by the action of snow and/or ice falling from the cable. This may cause fibre breakage.

Under the load of snow and/or ice, excessive fibre strain may easily be induced by wind pressure.

To suppress the fibre strain by snow loading and/or ice formation, the strength member should be selected to limit this strain to safe levels, and the cable profile may be selected to minimize snow loading. Alternatively, to suppress fibre strain, the cable may be lashed to a high-strength support strand. Cable should be designed and installed to provide stability of the transmission characteristics, cable sag/tension, fatigue of the strength member and tower/pole loading.

5.3.10 Strong electric fields

Metal-free aerial cables installed in the high-voltage environment of power lines are susceptible to the influence of the electric field of these power lines which may lead to phenomena such as corona, arcing and tracking of the cable sheath.

To prevent damage, the cable should be installed on the power transmission lines in a position of minimum field strength and/or special cable sheath materials may be used depending on the level of the electric field. Also, the effect of sheath marking should not cause any deterioration of the sheath in these circumstances.

6 Cable construction

For aerial application, special cable structure may be adopted such as Self-supporting cable, ADSS and a cable designed for lashing.

6.1 Fibre coatings

6.1.1 Primary coating

Silica fibre itself has an intrinsically high strength, but its strength is reduced by surface flaws. A primary coating should therefore be applied immediately after drawing the fibre size, and may consist of multiple layers.

The optical fibre should be proof-tested. In order to guarantee long-term reliability under service conditions, the proof-test strain may be specified, taking into account the permissible strain and required lifetime.

In order to prepare for splicing, it should be possible to remove the primary coating without damage to the fibre, and without the use of materials or methods considered to be hazardous or dangerous.

The composition of the primary coating, coloured if required, should be considered in relation to requirements of local light-injection and detection equipment used in conjunction with fibre jointing methods.

NOTE 1 – The primary-coated fibres should be proof tested with a strain equivalent to 1%. For certain applications, a larger proof-test strain may be necessary.

NOTE 2 – Further study is required to advise on suitable testing methods for local light-injection and detection.

6.1.2 Secondary coating

If using tight secondary coating of the fibre, the following items should be requested.

– It should be easily removable for fibre splicing.

– The nominal diameter should be between 800 µm and 900 µm, with the agreement between the user and supplier. A tolerance should be ± 50 µm. Non-concentricity between fibre and secondary coating should not exceed 75 µm unless otherwise agreed between the user and the supplier.

NOTE 1 – When a tight secondary coating is used, it may be difficult to use local light-injection and detection equipment associated with fibre jointing methods.

NOTE 2 – Mechanical coupling between fibre and cable should be carefully designed. While quite low coupling may cause fibre movement during the installation process, high coupling causes high fibre stress when the cable is bent.

6.1.3 Fibre identification

Fibre should be easily identified by colour and/or position within the cable core. If a colouring method is used, the colours should retain good colour-fast properties during the lifetime of the cable.

6.1.4 Removability of coating

The primary and secondary protections should be easy to remove and should not hinder the splicing, or fitting of fibre to optical connectors.

6.2 Cable elements

The makeup of the cable core – in particular the number of fibres, their method of protection and identification, the location of strength members and metallic wires or pairs, if required – should be clearly defined.

6.2.1 Optic fibre Ribbon

Optical fibre ribbons consist of optical fibres aligned in a row. Optical fibre ribbons are divided into two types, based on the method used to bind optical fibres. One is the edge-bonded type, the other is the encapsulated type, shown in Figures 1 and 2 respectively. In the case of the edge-bonded type, optical fibres are bound by adhesive material located between the optical fibres. When the encapsulated type is adopted, the optical fibres are bound by coating material. In ribbons, optical fibres shall remain parallel, and do not cross. Each ribbon in a cable is identified by a printed legend or unique colour. Optical fibre ribbons are specified in IEC 60794-3.

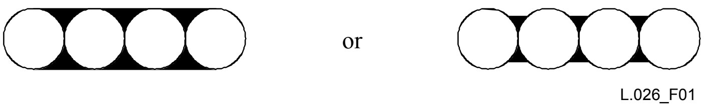

Figure 1/L.26 – Cross-section of a typical edge-bonded ribbon

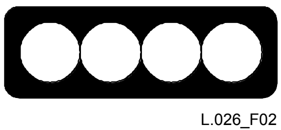

Figure 2/L.26 – Cross-section of a typical encapsulated ribbon

6.2.2 Slotted core

In order to avoid direct pressure from the outside of the cable on optical fibres, optical fibres and/or ribbon fibres are located in slots. Usually, slots are provided in a helical or SZ configuration on a cylindrical rod. The slotted core usually contains a strength member. A strength member shall adhere tightly to the slotted core in order to obtain temperature stability and avoid their separation when a pulling force is applied during installation. Water-blocking material may be contained in the slots.

6.2.3 Tube

A tube construction is frequently used for protecting and gathering optical fibres and/or ribbon fibres. A composite wall may be used for reinforcement of the tube's mechanical strength. Water-blocking material may be contained in the tube.

6.2.4 Strength member

The cable should be designed with sufficient strength members to meet installation and service conditions so that the fibres are not subjected to strain levels in excess of those agreed between customer and supplier. The strength member may be either metallic or non-metallic.

The aerial cable may be classified as a self-supporting type, when it has, for example, a figure-of-eight construction, or when the strength members are located in the cable core and/or in the sheath. Alternatively, the cable may be supported by attaching it to a supporting strand.

A knowledge of span, sag, wind and ice-loading is necessary to design a cable for use in aerial applications.

6.2.5 Water-blocking materials

Filling a cable with water-blocking material or wrapping the cable core with layers of water-swellable material are two means of protecting the fibres from water ingress. A water-blocking element (tapes, filling compound, water-swelling powder or combination of materials) may be used. Any material used should not be harmful to personnel. The materials in the cable should be compatible with each other, and in particular should not adversely affect the fibre. These materials should not hinder splicing and/or connection operations.

6.3 Sheath

The cable core shall be covered with a sheath or sheaths suitable for the relevant environmental and mechanical conditions associated with storage, installation and operation. The sheath may be of a composite construction and may include strength members.

Sheath considerations for optical fibre cables are generally the same as for metallic conductor cables. The minimum acceptable thickness of the sheath should be stated, together with any maximum and minimum allowable overall diameter of the cable.

The outer sheath should be resistant to the degradation due to ultraviolet radiation and biotic hazards.

NOTE – One of the most common sheath materials is polyethylene (see clause 22 of IEC 60708-1). There may, however be, some conditions, where it is necessary, for example, to limit fire hazards; special materials should be used for the cable sheath in such situations, as well as where the sheath is subjected to strong electric fields (see 5.3.10).

6.4 Armour

Where additional tensile strength or protection from external damage (crush, impact, rodents…) is required, armouring should be provided.

Armouring considerations for optical fibre cables are generally the same as for metallic conductor cables. However, hydrogen generation due to corrosion should be taken into consideration. It should be remembered that the advantages of optical fibre cables, such as lightness and flexibility, will be reduced when armour is provided.

Armouring for metal-free cables may consist of aramid yarns, glass-fibre-reinforced strands or strapping tape, etc.

6.5 Identification of cable

If a visual identification is required to distinguish an optical fibre cable from a metallic cable, this can be done by visibly marking the sheath of the aerial optical fibre cable. For identifying cables, imprinting, surface printing, hot foil, embossing or sintering can be used by agreement between user and supplier.

7 Test methods

7.1 Test methods for cable elements

7.1.1 Tests applicable to optical fibres

In this clause, optical fibres test methods related to splicing are described. Mechanical and optical characteristics test methods for optical fibres are described in ITU-T Recs G.650.1 and G.651.

7.1.1.1 Dimensions

For measuring the secondary coating diameter, method IEC 60793-1-21-B shall be used.

For measuring tube, slotted core and other ruggedized elements, method IEC 60793-1-21-B or IEC 60189 shall be used.

7.1.1.2 Coating strippability

For measuring the strippability of primary or secondary fibre coatings, IEC 60793-1-32 shall be used.

7.1.1.3 Compatibility with filling materials

When fibres come into contact with a filling material used for waterproofing, the stability of the fibre coating and the filling material should be examined by tests after accelerated ageing.

The stability of the coating stripping force shall be tested in accordance with method IEC 60794-1-2-E5.

Dimension stability and coating transmissivity should be examined by the test method agreed upon by both user and supplier.

7.1.2 Tests applicable to tubes

7.1.2.1 Tube kink

For measuring kink characteristics of tubes, method IEC 60794-1-2-G7 shall be used.

7.1.3 Tests applicable to ribbons

7.1.3.1 Dimensions

For measuring ribbon dimensions, three test methods should be used appropriately. The first one, called a type test, is used to assess and verify the ribbon manufacturing process. The type test shall be carried out in accordance with method IEC 60794-1-2-G2, the visual measurement method. The two remaining methods are used only for product inspection after the manufacturing process has been carried out. These test methods are described in IEC 60794-1-2-G3, aperture gauge, and IEC 60794-1-2-G4, dial gauge. For inspection purposes, the visual measurement method can also be used.

7.1.3.2 Separability of individual fibres from a ribbon

A separability requirement can be given to a fibre ribbon if a user and a supplier agree. When separability is required, the following should be avoided in order to ensure long-term reliability of fibres:

– damage to the mechanical characteristics of fibres;

– removal of the colour of each fibre.

In fact, it is difficult to completely avoid such phenomena. However, if a user and a supplier agree, test method IEC 60794-1-2-G5 shall be used to examine fibre separability. Also, other special test methods can be used with agreement between the user and supplier.

7.2 Test methods for mechanical characteristics of the cable

This clause recommends appropriate tests and test methods for verifying the mechanical characteristics of aerial optical fibre cables.

7.2.1 Tensile strength

This test method applies to optical fibre cables installed under all environmental conditions.

Measurements are made to examine the behaviour of the fibre attenuation and fibre strain as a function of the load on a cable during installation and under severe weather conditions experienced in service.

The test shall be representative of the cable in service life, and be carried out in accordance with ITU-T Rec. L.14 and method IEC 60794-1-2-E1.

7.2.2 Bending

This test method applies to optical fibre cables installed under all environmental conditions.

The purpose of this test is to determine the ability of optical cables to withstand bending around a pulley, simulated by a test mandrel.

This test shall be carried out in accordance with method IEC 60794-1-2-E11.

7.2.3 Bending under tension (Sheave test)

This test method applies to optical fibre cables installed under all environmental conditions.

This test shall be performed to verify that the installation of the cable will not damage or degrade its performance.

This test shall be carried out in accordance with method IEC 60794-1-2-E9.

7.2.4 Crush

This test method applies to optical fibre cables installed under all environmental conditions.

This test shall be carried out in accordance with method IEC 60794-1-2-E3.

7.2.5 Abrasion resistance

This test method applies to optical fibre cables installed under all environmental conditions.

This subject needs further study, and is currently under consideration in method IEC 60794-1-2-E2A.

7.2.6 Torsion

This test method applies to optical fibre cables installed under all environmental conditions.

This test shall be carried out in accordance with method 60794-1-2-E7.

7.2.7 Impact

This test method applies to optical fibre cables installed under all environmental conditions.

This test shall be carried out in accordance with method IEC 60794-1-2-E4.

7.2.8 Kink

This test method applies to optical fibre cables installed under all environmental conditions.

This test shall be carried out in accordance with method IEC 60794-1-2-E10.

7.2.9 Repeated bending

This test shall be carried out in accordance with method IEC 60794-1-2-E6.

7.3 Test methods for environmental characteristics

This clause recommends the appropriate tests and test methods for verifying the environmental characteristics of optical fibre cables.

7.3.1 Temperature cycling

This test method applies to optical fibre cables installed under all environmental conditions.

Testing is by temperature cycling to determine the stability of the attenuation of a cabled fibre subjected to ambient temperature changes which may occur during storage, transportation and operation.

This test shall be carried out in accordance with method IEC 60794-1-2-Fl.

NOTE 1 – For aerial self-supporting cables, the stability of the attenuation may be measured with a specified tension applied to the cable sample.

NOTE 2 – When this Recommendation was revised, there was no international standard test method for sheath movement caused by temperature variation. However, sheath movement can be measured using the same test process for attenuation change caused by temperature variation, if a user and a supplier are agreed.

7.3.2 Longitudinal water penetration (applicable to filled cables only)

This test method applies to those outdoor cables that employ water-blocking methods and are installed under all environmental conditions. The intention is to check that the cable construction can prevent water penetration into all the interstices within the cable.

This test shall be carried out in accordance with method IEC 60794-1-2-F5.

7.3.3 Hydrogen

This test method applies to optical fibre cables installed under all environmental conditions.

In the case of a metal-free cable or one employing a moisture barrier sheath with a selection of cable components that are low in the generation of hydrogen, either by themselves or in combination with others (for example, water), the build-up of hydrogen gas within the cable core will not lead to a significant increase in optical loss.

For other cable constructions, ITU-T Rec. L.27 should be consulted.

7.3.4 Nuclear radiation

This test method assesses the suitability of optical fibre cables to be exposed to nuclear radiation.

This test shall be carried out in accordance with method IEC 60794-1-2-F7.

7.3.5 Aeolian vibration

This test method assesses the suitability of optical fibre cables for aerial application.

The test shall be carried out in accordance with method IEC 60794-1-2-E19.

7.3.6 Ultraviolet resistance

This test method applies to aerial optical fibre cable and assess the suitability of the cable sheath to withstand ultraviolet radiation.

This subject needs further study.

7.3.7 Sheath tracking

This test applies to aerial optical fibre cables used on high-voltage power lines.

This subject needs further study.

7.3.8 Shotgun

This method assesses the suitability of optical fibre cables where there is a risk of shotgun damage.

This test shall be carried out in accordance with method IEC 60794-1-2-E13.

7.3.9 Lightning

When a metallic material is used as a cable element, the lightning protection of the cable shall undergo a test described in ITU-T Rec. K.25 or be subject to agreement between the user and supplier.

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