IEC 60794-4-20

Edition 2.0 2018-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Optical fibre cables –
Part 4-20: Sectional specification – Aerial optical cables along electrical power lines – Family specification for ADSS (all dielectric self-supported) optical cables

Câbles à fibres optiques –
Partie 4-20: Spécification intermédiaire – Câbles optiques aériens le long des lignes électriques de puissance – Spécification de famille pour les câbles optiques autoporteurs entièrement diélectriques (ADSS)

IEC 60794-4-20:2018-08(en-fr)

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CONTENTS

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OPTICAL FIBRE CABLES –

Part 4-20: Sectional specification – Aerial optical cables along electrical power lines – Family specification for ADSS (all dielectric self-supported) optical cables

FOREWORD

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International Standard IEC 60794-4-20 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2012 and constitutes a technical revision.

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

a) this document has been streamlined by cross-referencing IEC 60794-1-1, IEC 60794-4 (all parts) and IEC 60794-1-2;
b) reference to the MICE table has been deleted;
c) the example of test method for particular environment in Annex C has been deleted;

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

FDIS	Report on voting
86A/1867/FDIS	86A/1876/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.

This document 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 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- withdrawn,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 4-20: Sectional specification – Aerial optical cables along electrical power lines – Family specification for ADSS (all dielectric self-supported) optical cables

1 Scope

This part of IEC 60794-4, which is a family specification, covers optical telecommunication cables, commonly with single-mode fibres[1] used primarily in overhead power lines applications. The cables can also be used in other overhead utility networks, such as for telephony or TV services. Requirements of the sectional specification IEC 60794-4 for aerial optical cables along electrical power lines are applicable to cables covered by this document.

This document covers the construction, mechanical, electrical, and optical performance, installation guidelines, acceptance criteria, test requirements, environmental considerations, and accessories compatibility for an all dielectric, self-supporting fibre optic (ADSS) cable. This document provides construction and performance requirements that ensure, within the guidelines of this document, that the required mechanical integrity of the cable components as well as optical fibre mechanical reliability and transmission parameters are maintained.

The ADSS cable consists of single mode optical fibres contained in one or more protective dielectric fibre optic units surrounded by or attached to suitable dielectric strength members and sheaths. The cable does not contain metallic components. An ADSS cable is designed to meet the optical and mechanical requirements under different installation, operating and environmental conditions and loadings, as described in Annex B.

This document excludes any "lashed" or "wrapped" OPAC cables included in IEC 60794-4. Figure 8 aerial cables are also excluded; they are specified in IEC 60794-3-20.

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 60793-2, *Optical fibres – Part 2: Product specifications – General*

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

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

IEC 60794-1-21:2015, *Optical fibre cables – Part 1-21: Generic specification – Basic optical cable test procedures – Mechanical test methods*

IEC 60794-1-22, *Optical fibre cables – Part 1-22: Generic specification – Basic optical cable test procedures – Environmental test methods*

[1] In some particular situations in the electrical industry, short overhead links can be also designed with multimode fibres.

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

ISO 9001, *Quality management systems – Requirements*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms, definitions and abbreviated terms given in IEC 60794-1-1 and IEC 60794-4 apply.

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 Optical fibres

Single-mode optical fibres shall be used that meet the requirements of IEC 60793-2-50. Other types of fibre can be agreed upon between the customer and the supplier; such fibre shall conform to IEC 60793-2. The cabled fibre shall conform to IEC 60794-4.

5 Cable elements

Refer to the relevant parts of the sectional specification IEC 60794-4.

6 Optical fibre cable constructions

6.1 General

The construction and characteristics of cable elements shall conform to IEC 60794-4. The cable shall not contain any metallic material.

6.2 Cable protection elements

In addition to the optical unit, the cable construction may consist of the following.

a) The outer sheath shall be a weather-resistant type material. In certain conditions, it shall be necessary to consider the use of a tracking-resistant sheath.

b) An ADSS cable shall contain self-supported systems that are integral to the cable. The purpose of the support system is to ensure that the cable meets the optical requirements under specified installation conditions, temperatures, and environmental loading for its whole operating design life.

c) The basic annular construction may have strength yarns (e.g. aramid yarns) or other dielectric strands or dielectric rods as a support structure. A single central dielectric shaft, channelled to accommodate the optical elements, is also accepted.

d) The cable shall be designed such that fibre strain does not exceed the limit allowed by the cable manufacturer under design tension limits of the cable (MAT). Maximum allowable fibre strain under MAT condition shall be ≤ 0,2 % for 0,69 GPa proof-tested fibres.

NOTE In some countries, a special requirement of shotgun resistance can be specified for aerial cables. ADSS cables covered by this document are not designed for such a condition. Cables with reinforced textile protection could still meet the dielectric condition, but the increase in diameter and weight would make necessary a significant enhancement of the tensile performance of the cable.

7 Main requirements for installation and operating conditions

Operating conditions are particularly important for ADSS cables.

Installation and operating conditions shall be agreed between the customer and the supplier. For the ADSS cable, a detailed study of the field conditions and a certain level of technical support by the supplier or third-party expert should precede the agreement. Annex B provides a general view of such considerations.

The type of fittings and hardware used to attach the ADSS to the structures shall be approved between the customer and the supplier. Their compatibility shall be verified in accordance with 9.15 and the fittings product specification.

8 Cable design considerations

Table 1 is a summary of cable characteristics which may be of importance as specifications to both the customer and the supplier. Table 2 includes optional engineering parameters relevant for the design and installation of the overhead line with an ADSS cable. Other characteristics may be mutually agreed upon by both the customer and the supplier. A complete blank specification is shown in Annex D.

Table 1 – Cable design characteristics

Ref.	Characteristics	Units
4	Number and type of fibres	NA
-	Modularity of cable core	NA
6	Detailed description of cable construction	NA
-	Overall cable diameter	mm
	Cable weight	kg/km
9.2	MAT (maximum allowable tension)	kN
9-10	Allowable temperature for storage, installation and operation	°C
9.3	Minimum bending diameter during installation	mm
9.4	Minimum bending diameter installed	mm

Table 2 – Optional parameters (if required by customer)

Ref.	Characteristics	Units
9.13	MIT, maximum installation (or sagging) load	kN
-	Modulus of elasticity	MPa
-	Coefficient of thermal expansion	10^{-6}/°C
9.2	Fibre strain at MAT load	%
Annex B	Zero strain margin	kN
	Environmental loading conditions – Reference to local or regional installation code	NA
	Recommended span and sag under MAT limit	m/%
C.3	Maximum ADSS cable space potential exposure (generally specified for a low-pollution environment unless specified otherwise by the customer)	kV

9 Cable tests

9.1 General

In mechanical tests, the general optical criteria is no change in attenuation, as described in IEC 60794-1-1 and IEC 60794-4.

In some environmental and installation tests, some increase is accepted. These are the sheave test, the aeolian vibration test and the galloping test.

The number of fibres tested shall be representative of the cable design according to fibre sampling indicated IEC 60794-1-1. Different sampling can be agreed between the customer and the supplier.

The tests applicable for aerial cables are listed below. The minimum acceptance criteria for the different designs of cables shall be indicated in the product specification.

9.2 Tensile performance

9.2.1 General

The cable should be tested in accordance with IEC 60794-1-21, method E1. Under this test, the cables shall meet the specified MAT value.

9.2.2 Family requirement

Loaded with MAT, no change in attenuation at 1 550 nm shall be measured, and the strain in the fibre shall be ≤ 0.2 % for 0,69 GPa proof-tested fibres. Other values can be agreed between the customer and the supplier.

NOTE Strain limit values for fibres with different proof test values are under study.

9.2.3 Test conditions

- Test set in a straight path in accordance with Figure 1 of IEC 60794-1-21:2015 (no drums or pulleys allowed).
- The cable shall be terminated with adequate dead-end fittings.
- Sample length of 25 m minimum.
- MAT is sustained for 1 h.
- The fibres shall be loop-back spliced so that a minimum of 100 m of fibre are under test.

9.3 Sheave test

9.3.1 General

The cable shall be tested in accordance with method E18B of IEC 60794-1-21.

9.3.2 Family requirement

Maximum permanent increase in attenuation: 0,10 dB at 1 550 nm.

No physical damage in cable elements.

9.3.3 Test conditions

- Method E18B of IEC 60794-1-21, procedure 1 or 2.
- Tension level applied during test: maximum stringing load (or MIT).
- Length of the cable: 9 m minimum. Length bent under tension: 2 m.

- The cable should be terminated with the recommended dead-end fittings.
- The fibres shall be loop-back spliced so that a minimum of 100 m of fibre are under test.
- Diameter (D) of roller/cylinders ≥ manufacturer's minimum bend diameter (approximately ≥ 40 times cable outside diameter is recommended).
- Bending angle: 45° ±15°.
- Moving speed: 1 m/s ≤ speed ≤ 10 m/s.
- Number of complete moving cycles: 20.

9.4 Repeated bending

9.4.1 General

The cable shall be tested in accordance with the method specified in IEC 60794-1-21, method E6.

9.4.2 Family requirements

Under visual examination without magnification, there shall be no damage to the sheath or cable elements. There shall be no change in attenuation at 1 550 nm after the completion of the test.

9.4.3 Test conditions

- Bending radius: 20 d.
- Number of cycles: 25.

Particular conditions may be agreed between the customer and the supplier.

9.5 Impact

9.5.1 General

The cable construction shall be tested in accordance with the method specified in IEC 60794-1-21, method E4.

9.5.2 Family requirements

Under visual examination without magnification, there shall be no damage to the sheath or to the cable elements. The imprint of the striking surface on the sheath is not considered mechanical damage.

There shall be no change in attenuation at 1 550 nm.

9.5.3 Test conditions

- Striking surface radius: 300 mm.
- Impact energy: 10 J.
- Number of impacts: three, each in a different place spaced not less than 500 mm apart.

NOTE these values are for general purpose use. Particular requirement could be included in product specification.

9.6 Crush

9.6.1 General

The cable shall be tested in accordance with IEC 60794-1-21, method E3, without physical damage or change in attenuation.

9.6.2 Test requirements

Under visual examination, there shall be no damage to the sheath or to the cable elements. The imprint of the plate or mandrel on the sheath is not considered mechanical damage.

Long term ≥ 10 min. No change in attenuation (prior to release of load).

Short term ≥ 1 min. No change in attenuation (after test).

9.6.3 Test conditions

- Load (plate/plate): 2,2 kN for short-term load, 1,1 kN for long-term load.
- Duration of load: 1 min of short-term load, followed by 10 min of long-term load.
- Number of tests: 3.
- Spacing between test places: 500 mm.

NOTE These values are for general purpose use. Particular requirements can be included in a product specification.

9.7 Torsion

9.7.1 General

The cable shall be tested in accordance with IEC 60794-1-21, method E7.

9.7.2 Test requirements

Under visual examination without magnification, there shall be no damage to the sheath or to the cable elements.

No change on attenuation after the test at 1 550 nm.

9.8 Aeolian vibration test

9.8.1 General

The resistance of the cable to aeolian vibration shall be tested in accordance with method E19 of IEC 60794-1-21.

9.8.2 Family requirements

Under visual examination without magnification, there shall be no damage to the sheath or to the cable elements. The variation on attenuation after the test shall be no greater than 0,10 dB at 1 550 nm.

9.8.3 Test conditions

The cable should be terminated with the recommended dead-end and suspension fittings.

9.8.4 Parameters to be reported

- Length of spans.
- Length of cable and fibres tested.
- Vibration mode/characteristics maintained during the test.
- Characteristics of measuring equipment.
- Ambient temperature and humidity during the test.
- Mass/unit length and diameter of the cable.

9.9 Low frequency vibration test (galloping test)

9.9.1 General

The resistance of the cable to low frequency vibration shall be tested in accordance with IEC 60794-1-21, method E26. This test applies for ADSS cables to be installed in areas where ice build-up and/or strong winds are envisaged.

9.9.2 Family requirements

Permanent or temporary increase in attenuation at 1 550 nm shall be ≤ 0,10 dB.

The sheath shall have no cracks or splits.

9.9.3 Test conditions

The final optical measurement shall be taken at least 2 h after the completion of the vibration test. A section of cable from the location of the hardware support shall be loaded to the MAT, and the attenuation shall comply with 9.2.1.

9.10 Temperature cycling

9.10.1 General

The cable shall be tested in accordance with the method specified in IEC 60794-1-22, method F1, one-cycle procedure with the temperature limits, in accordance with operation limits in the product specification, or combined test procedure if different storage limits are specified.

9.10.2 Family requirements

For T_A and T_B (T_{A1} and T_{B1} in combined test), there shall be no change in attenuation from the reference room temperature measurement when measured in the 1 550 nm region or at the operational wavelength when specified by the user. T_{A1} and T_{B1} temperature levels are only required during the last cycle.

For T_{A2} and T_{B2}, the change in attenuation coefficient shall be ≤ 0,15 dB/km during the last cycle from the reference room temperature measurement.

On completion of the test, there shall be no change in attenuation. The measurement shall be made in the 1 550 nm region.

9.10.3 Test conditions

- Sample length: finished cable length of at least 500 m.
- High temperature, T_B for one-cycle procedure (T_{B1} for combined test): +60 °C.
- High temperature, T_{B2}: +70 °C (only for combined test).
- Low temperature, T_A for one-cycle procedure (T_{A1} for combined test): −20 °C.
- Low temperature, T_{A2}: −40 °C (only for combined test).
- Rate of heating: sufficiently slow so that the effect of changing the temperature does not cause temperature shock or 40 °C/h if not specified.
- t_1: enough time to get temperature stability in the sample.
- Number of cycles: 2. Additional cycles may be required depending on user requirements.
- Temperature values may vary depending on user requirements.

9.11 Water penetration

The cable shall be tested in accordance with IEC 60794-1-22, method F5B for jelly filled cables or F5C for all-dry cables.

No water shall be detected at the unsealed end of the sample during and at the end of the test.

9.12 Cable UV resistance

The outer sheath shall be made of UV-stabilized weather-resistant material in accordance with IEC 60794-1-22, method F14.

Further requirements are under consideration.

9.13 Tracking and erosion resistance test

Dielectric cables installed on power lines are exposed to electrical fields. The magnitude of this field space potential exposure depends on the line voltage, tower design, conductor configuration, and installation location for the ADSS. Together with specific environmental conditions, especially desert or highly polluted areas close to the sea, this can lead to electrical degradation (e.g. dry-band arcing), which can cause severe damage to the outer cable sheath and finally can cause a total cable failure. The sensitivity to electrical degradation depends on a combination of the space potential, the cable, environment, and sheath material used. In areas with higher space potentials or poor environmental conditions, track resistant sheath materials may be essential to alleviate the risk to product life.

Experience has shown that the formerly used > 12 kV space potential transition point for using track resistant sheath materials may be too high depending on the environmental conditions. Under certain environmental conditions as mentioned above, tracking-resistant sheaths may be needed with space potentials down to 4 kV. Even with tracking-resistant sheath materials, special consideration about the feasibility of ADSS applications is required for levels higher than 20 kV.

Tracking-resistant sheath materials shall be used in the following field conditions:

a) power lines with an operation voltage of 150 kV or higher;

b) power lines producing space potential of 4 kV or higher in salty or polluted areas.

If the ADSS cable is to be used in telecommunication poles or low-voltage distribution lines, track-resistant requirements can be waived.

Two current options for evaluating the quality of track-resistant sheath materials are given in Annex C:

1) salt fog method: evaluates cable in a wet condition (continuous salt water spray);

2) alternating wet dry cycles with different current levels to reflect different degrees of resistivity resulting from varying degrees of regional environmental conditions.

Other test conditions may be needed to evaluate ADSS tracking resistance for specific environments.

9.14 Creep

There is no pass/fail criterion for creep. This parameter is an engineering guidance to the behaviour of the cable during its working life. The cable creep behaviour should be determined using a test method agreed between the customer and the supplier. Suitable tests are IEC 60794-1-21, method E32 or found in IEC 61395.