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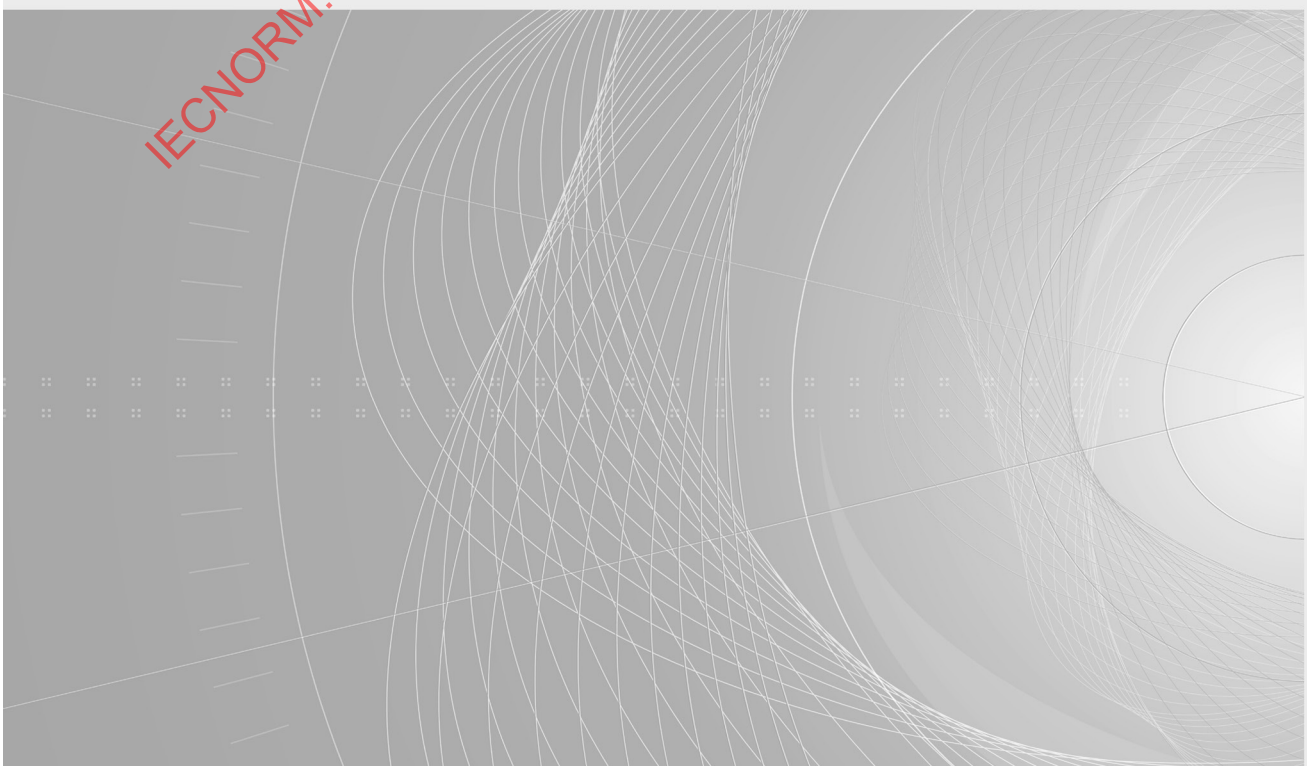
INTERNATIONAL STANDARD

Hybrid communication cables – Part 3-10: Outdoor hybrid cables – Family specification for FTTA hybrid communication cables



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HYBRID COMMUNICATION CABLES –

Part 3-10: Outdoor hybrid cables – Family specification for FTTA hybrid communication cables

FOREWORD

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IEC 62807-3-10 has been prepared by subcommittee 46C: Wires and symmetric cables, of IEC technical committee 46: Cables, wires, waveguides, RF connectors, RF and microwave passive components and accessories. It is an International Standard.

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

Draft	Report on voting
46C/1246/FDIS	46C/1251/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

This part of IEC 62807 is to be used in conjunction with IEC 62807-3:2023. It is based on the first edition of that document.

A list of all parts in the IEC 62807 series, published under the general title *Hybrid communication 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 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- withdrawn,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.

HYBRID COMMUNICATION CABLES –

Part 3-10: Outdoor hybrid cables – Family specification for FTTA hybrid communication cables

1 Scope

This part of IEC 62807 is a family specification for FTTA (Fibre-To-The-Antenna) outdoor hybrid communication cables. It specifies the design and construction, rated values and characteristics, requirements and test methods, packaging and quality assurance, etc.

The FTTA hybrid communication cables are typically but not only installed between the Base Band Unit (BBU) and Remote Radio Unit (RRU; or often called RRH – Remote Radio Head or AAU – Active Antenna Unit), and other scenario that supply electric current to optical communication equipment.

The FTTA hybrid communication cables contain optical fibre elements and current carrying elements under a common outer sheath or other constructions unifying the elements. The current carrying elements are used only to supply power to the equipment within the communication network. The current carrying elements are not used for electricity distribution or transmission, nor for power supply to domestic appliances.

The relationship between each of the MICE classifications in ISO/IEC 11801-1, the requirements and test methods of hybrid cables being proposed in a specific application are fully considered and aligned (see Annex A).

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 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60227-1, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 1: General requirements*

IEC 60228:2004, *Conductors of insulated cables*

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

IEC 60502-1, *Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) − Part 1: Cables for rated voltages of 1 kV (Um = 1,2 kV) and 3 kV (Um = 3,6 kV)*

IEC 60793-1-40, *Optical fibres – Part 1-40: Attenuation measurement methods*

IEC 60793-1-44, *Optical fibres – Part 1-44: Measurement methods and test procedures – Cut-off wavelength*

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

IEC 60793-1-48, *Optical fibres – Part 1-48: Measurement methods and test procedures – Polarization mode dispersion*

IEC 60793-2-10, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibres*

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 1-1: Generic specification − General*

IEC 60794-1-21, *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*

IEC 60794-1-31, *Optical fibre cables – Part 1-31: Generic specification – Optical cable elements – Optical fibre ribbon*

IEC 60794-1-403, *Optical fibre cables – Part 1-403: Generic specification – Basic optical cable test procedures – Electrical test methods – Electrical continuity test of cable metallic elements, method H3*

IEC 60794-2, *Optical fibre cables – Part 2: Indoor cables − Sectional specification*

IEC 60794-3:2022, *Optical fibre cables – Part 3: Outdoor cables – Sectional specification*

IEC 62807-3:2023, *Hybrid communication cables – Part 3: Outdoor hybrid cables – Sectional specification*

IEC 62821 (all parts), *Electric cables – Halogen-free, low smoke, thermoplastic insulated and sheathed cables of rated voltages up to and including 450/750 V*

IEC 62821-1, *Electric cables – Halogen-free, low smoke, thermoplastic insulated and sheathed cables of rated voltages up to and including 450/750 V – Part 1: General requirements*

IEC 63294, *Test methods for electric cables with rated voltages up to and including 450/750 V*

ISO/IEC 11801-1:2017, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms, definitions, symbols and abbreviated terms given in IEC 62807-3, IEC 60794-1-1, IEC 60227-1, IEC 62821-1 and IEC 60502-1 apply.

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

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

4 Design and construction

4.1 General

This hybrid cable is typically composed of optical fibre elements and current carrying elements with strength member, filler, yarn, tape, ripcord, screening and/or shield, moisture barrier, sheath or armouring, etc. The hybrid cable shall be designed to meet the requirements of cable application and operating environment.

Some examples of structures of typical FTTA hybrid cables are shown in Annex B. Annex C describes a blank detail specification for FTTA hybrid cables and incorporates some minimum requirements.

4.2 Optical fibre elements

The optical fibre elements shall be in accordance with the following:

a) The optical fibre elements shall be composed of one or more optical fibres, tight or semi-tight buffered fibres, fibre ribbons, buffer tubes, other optical core structures, or independent optical fibre cables (such as loose tube cable). The construction and number of optical fibre elements shall be specified in the relevant specification.

b) The optical fibres can be single-mode fibres and shall comply with the requirements of IEC 60793-2-50, or may be multi-mode fibres and shall comply with the requirements of IEC 60793-2-10.

c) The tight buffer shall be removable from the fibre for termination. The semi-tight buffer shall be easily removable from the fibre in longer strip lengths than the tight buffer. The tight or semi-tight buffer should be made of thermoplastic material or ultraviolet cured resin.

d) The optical fibre ribbon shall comply with IEC 60794-1-31 or the relevant specification.

e) Optical core structures shall comply with IEC 60794-2 or IEC 60794-3 or the relevant specification.

f) For ease of identification, all the optical fibre and optical fibre elements shall be identified, for example colour coding, ring marking, printing or some other methods agreed between the customer and supplier. If the primary coated fibres are coloured for identification, the coloured coating shall be readily identifiable throughout the lifetime of the cable and the coloured coating shall comply with IEC 60304. Additional information can be found in IEC TR 63194.

g) The material of the optical elements' sheath or loose tube may be polyethylene, polypropylene, polybutylene terephthalate (PBT), low smoke halogen free material, polyvinyl chloride, or other materials suitable to the application.

4.3 Current carrying elements

The design of conductor cross-sections shall be in accordance with the rated voltage, transmission distance and consumed power of the powered device. Under normal operating conditions, the temperature increase caused by the power transmission shall not exceed the maximum conductor temperature of the current carrying elements as specified in Table D.1 of Annex D.

Current carrying elements shall meet the requirements of the appropriate specification before being assembled into hybrid cables. For example, for a rating voltage up to and including 450/750 V, current carrying elements shall meet the requirements of the IEC 60227 series or the IEC 62821 series. For a rating voltage of 0,6/1 kV, the current carrying elements shall meet the requirements of IEC 60502-1.

The conductor should be continuous and without joints through the length of the hybrid cable.

4.4 Strength member

For a layer stranded cable core with strength members in the centre of the optical element, materials specified in IEC 60794-3 should be used. Other strength members shall be placed in a suitable position, according to the structure of the hybrid cable.

4.5 Filler

To make the cable core achieve its design shape, fillers with specified outside diameter or other shape are used to fill the vacancy in the cable core.

4.6 Yarn

Hybrid cables may have yarns. Those yarns should be non-hygroscopic and non-oil absorption with enough tensile strength to meet cable tensile requirements. Water blocking yarns may be used.

4.7 Tape

The cable core may be protected by a tape or tapes, applied longitudinally or helically. The tape may provide thermal insulation and/or provide dielectric properties. Yarns per 4.6 may be used in conjunction with tapes.

The material may be polyester, polyester non-woven tape, water-blocking tape or other materials specified in the detail specifications.

4.8 Ripcord

If required, a ripcord(s) may be provided over the cable core and should be continuous through the entire length of the hybrid cable. It shall be non-hygroscopic, non-oil absorption and have enough strength to cut the hybrid cable sheath.

The ripcord shall be capable of ripping the sheath for a distance of 1 m when tested in accordance with IEC 60794-1-21, method E25.

4.9 Screen and/or shield

A screen may be used to minimize electromagnetic noise induced by currents. The screen may be outside the metallic core components or within them.

Screens or shields may be single/multi-layer longitudinal or wrapped metallic tapes, or may be foils laminated to a plastic tape, or single/multi-layer wrapped or braided (woven) wires, or a combination of all of these.

In case a collective screen is needed for national safety region, the design shall follow these requirements i.e. the same cross-section as the current carrying elements. When a braided single-layer shield or screen is employed, the braid coverage factor should not be less than 80 %. When a braided double-layer shield or screen is employed, or a combined structure of metal band and woven layer, the braid coverage factor should not be less than 30 %. Different coverage factors for both cases could be agreed between customer and supplier and those should be indicated in the data sheet. Annex E provides an example of how to calculate the coverage factor formulae of the shield. The braided screen or shield can be on its own or be part of another tape screen.

4.10 Moisture barrier

The screen or shield may act as a moisture barrier when it is a metallic foil or tape. It shall be continuous and has a hermetically sealed overlap or seamless construction.

4.11 Inner sheath

If needed, an inner sheath may be applied between the cable core(s) and the armouring layer. The material of the inner sheath may vary according to the design of the cable and customer requirements.

4.12 Armouring

Where additional tensile strength or protection from external damage is required, armouring may be provided. The armouring is generally applied under the outer sheath. Tapes, wire wrapping and braiding can be of metallic or dielectric materials and can be applied as agreed between the customer and manufacturer.

4.13 Outer sheath

The outer sheath should protect the cable against environmental conditions (such as humidity, UV radiation) and mechanical loads (such as crush, tensile, impact). Suitable materials, such as polyethylene, polypropylene, PVC, polyurethane and flame-retardant low smoke polyolefins can be used.

4.14 Sheath marking

If required, the cable shall be marked according to the agreement between the customer and supplier, or according to IEC 60794-3:2022, 6.7.

5 Rated values and characteristics

5.1 Minimum bending radius for installation

Minimum bending diameter for installation:

Static: 20 × D (unarmoured), 30 × D (armoured)

Dynamic: 40 × D (unarmoured), 60 × D (armoured)

NOTE D is the outer diameter of hybrid cable; for non-round shape hybrid cable, the diameter is the minor dimension, in mm.

5.2 Temperature range

Operation environment temperature range: −25 °C to +70 °C [1] or −40 °C to +70 °C [2]

An additional temperature range can be agreed between customer and supplier.

NOTE The maximum temperatures of conductors are given in Table D.1.

5.3 Rated voltages

Rated voltages: 300/500 V, 450/750 V, or 0,6/1 kV

[1] This environment performance reaches C_2 in MICE classification.

[2] This environment performance reaches C_3 in MICE classification.

NOTE For a guide on how to use or select cables, including limitations on current carrying capacity, refer to IEC 62440 for rated voltages up to 450/750 V, or to IEC 60183 for rated voltages up to 0,6/1 kV and above.

6 Requirements and test methods

6.1 General

Compliance with the specification requirements of the overall hybrid cable shall be verified by carrying out tests selected from Clause 6, and in accordance with the safety requirements as defined by the specific application.

It is not intended that all tests be carried out in all cases. The tests to be applied on cabled optical fibre elements should be agreed between the customer and the supplier. Current carrying elements shall be tested according to the requirements specified in this document and cited references.

NOTE The issue of DC rating and DC stability is currently under consideration and needs to be further addressed.

6.2 Construction and length inspection

6.2.1 Construction

The manufacturer shall implement measures to ensure that the construction, colour coding and various structure dimensions comply with the requirements. The visual and mechanical inspection shall be at the position which is at least 100 mm away from the cable end.

6.2.2 Cable length and marking accuracy

The cable length shall be determined by measuring the points at which the meter mark can be identified near the end of the cable (if the cable has been re-printed (marked), choose this marking as the reference). The actual length of the cable shall be within $^{+1}_{-0}$ % of the length indicated by the length marking.

Measure a segment of the cable metre marking using a calibrated length scale or tape. The measured length under test shall not be less than 3 m. The measured segment shall be at least 10 m inside the run of the cable. The measured length under test shall match the calibrated length scale to within ± 0,5 %.

6.3 Optical transmission requirements for cabled optical fibre

Unless otherwise specified in the detail specification, the cabled optical fibre elements shall conform to Table 1.

Table 1 – Optical transmission requirements for cabled optical fibre elements

No.	Parameter	Test procedure	Requirements/Remarks
1	Attenuation coefficient at 1 550 nm	IEC 60793-1-40	≤0,30 dB/km for B-652.D ≤0,30 dB/km for B-657
2	Attenuation coefficient at 1 300 nm	IEC 60793-1-40	≤1,5 dB/km for A1-OM1, A1-OM2, A1-OM3, A1-OM4 and A1-OM5
3	Cut-off wavelength (Single-mode optical fibre only)	IEC 60793-1-44	In accordance with IEC 60794-1-1
4	Polarization mode dispersion (PMD) (Single-mode optical fibre only)	IEC 60793-1-48	In accordance with IEC 60794-1-1
5	Changes in attenuation	IEC 60793-1-46	During and/or after mechanical tests, the change in attenuation of the cable shall be in accordance with the 6.5. During and/or after temperature cycling tests, the change in attenuation of the cable shall be in accordance with 6.6.1.

6.4 Electrical requirements

6.4.1 Conductor DC resistance

a) Family requirements

The measured value of resistance shall be converted to the value at the standard temperature of 20 °C. The conductor DC resistance of the cable shall conform to the relevant specification.

b) Test conditions

Method: IEC 60228 or other method agreed between customer and supplier

Test equipment: A current source in conjunction with a voltmeter

Sample length under test: Not less than 1 m

6.4.2 Withstand voltage of dielectric

a) Family requirements

There shall be no breakdown or flashover when the test voltage specified in the relevant specification is applied.

b) Test conditions

Method: For 300/500 V and 450/750 V cables, the methods in IEC 63294 shall be used.

For 0,6/1 kV cables, the method in IEC 60502-1 shall be used.

If a collective screen is present, the same test for core to screen shall be performed as for core to core.

Test voltages: Test voltages for different rated voltages are given in Table 2.

Table 2 – Test voltages for different rated voltages

Rated voltage (AC) V	Test voltage (AC) kV	Alternative test voltage (DC) kV
600/1000	3,5	8,4
450/750	2,5	6,0
300/500	2,0	4,8

NOTE: The Voltage application time might differ between the different voltage ratings. Attention shall be paid to the duration of the test. The voltage application time shall be as in the relevant test method stated in this clause

6.4.3 Insulation resistance of current carrying elements

a) Family requirements

The insulation resistance shall be ≥ 10 MΩ·km for PVC or low smoke halogen free.

The insulation resistance shall be ≥ 5 000 MΩ·km for PE or XLPE.

b) Test conditions

The test shall be conducted in an ambient temperature of 20 °C.

Methods:	For 300/500 V and 450/750 V cables, the methods in IEC 63294 shall be used. For 0,6/1 kV cables, the method in IEC 60502-1 shall be used. The hot water may be 70 °C or according to the relevant detail specifications.
Test voltage:	80 V DC to 500 V DC.

6.5 Mechanical requirements

6.5.1 General

The mechanical tests will affect all the elements of the cable to some degree. Criteria to be considered are further explained in each of the following subclauses on mechanical testing. The cable shall be tested as a whole, rather than as discrete elements.

Tests on single-mode fibre cables shall be carried out at 1 550 nm. Multi-mode fibre cables shall be tested at 1 300 nm. Measurement at other wavelengths or range of wavelengths may be agreed upon between the customer and the supplier.

6.5.2 Tensile performance

a) Family requirements

1) For optical fibre elements

While the cable is under short-term tensile load (TM, rated tensile load):

- The axial fibre strain shall be < 60 % of the fibre proof strain.
- The attenuation shall be measured and recorded.

While the cable is under the long-term tensile load (TL, residual load):

- The axial fibre strain shall be:
  - < 20 % of fibre proof test, for fibre proof tested to ≤ 1 % strain (e.g., 0,69 GPa, 0,2 % absolute strain),
  - < 17 % of fibre proof test, for fibre proof tested to greater than 1 % to 2 % strain (e.g., 0,69 GPa to 1,38 GPa, 0,34 % absolute strain for 2 % proof tested fibre).

NOTE For fibres proof tested at levels above 1 % strain, the safe long-term load will not scale linearly with proof strain, so a lower percentage of the proof stain is applicable. There is no agreement for strain limits for proof tests above 2 % strain.

- The change in attenuation shall be:

  Single-mode fibre: no change in attenuation as defined in IEC 60794-1-1.

  Multi-mode fibre: no change in attenuation as defined in IEC 60794-1-1.

After the test, there shall be no change in attenuation as defined in IEC 60794-1-1.

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

2) For current carrying elements

While the cable is under short-term tensile load (TM, rated tensile load), no current carrying element shall exceed the yield point as defined by the relevant specification. The conductor(s) and screen(s) shall be continuous when tested in accordance with IEC 60794-1-403.

The conductor DC resistance, withstand voltage of dielectric and insulation resistance of current carrying elements shall comply with 6.4.1, 6.4.2 and 6.4.3.

b) Test conditions

Method:	IEC 60794-1-21, Method E1
Length of sample:	Sufficient to achieve the desired accuracy of measurement of attenuation change and shall be agreed between customer and supplier.
Diameter of test pulleys:	Typically 1 m, but no less than 30 D.
Tensile load on cable:	Long-term tensile load (T_L): 0,05 × W. The minimum value should be 200 N and the maximum value should be 1,5 kN. Short-term tensile load (T_M): 0,15 × W. The minimum value should be 400 N and the maximum value should be 3 kN.
Duration of load:	Minimum 10 min.
Rate of tension increase:	100 N/min or 100 mm/min.

6.5.3 Crush

a) Family requirements

Under long-term load and after removal of the short-term load, there shall be no change in attenuation as defined in IEC 60794-1-1 for optical fibre elements. Under visual examination after test, there shall be no magnification damage to the sheath or to the cable elements. The conductor(s) and screen(s) shall be continuous when tested in accordance with IEC 60794-1-403. The withstand voltage of dielectric of current carrying elements shall comply with 6.4.2.

b) Test conditions

Method:	IEC 60794-1-21, Method E3A
Load (short term):	1,5 kN (unarmoured); 2,2 kN (armoured) [3]
Load (long term):	0,75 kN (unarmoured); 1,1 kN (armoured) [4]

NOTE A different load set can be agreed between customer and supplier.

6.5.4 Impact

a) 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 permanent change in attenuation after the test for optical fibre elements. The conductor(s) and screen(s) shall be continuous when tested in accordance with IEC 60794-1-403. The withstand voltage of dielectric of current carrying elements shall comply with 6.4.2.

b) Test conditions

Method:	IEC 60794-1-21, Method E4
Impact energy:	unarmoured cable: 10 J [5] Armoured cable: 20 J to 30 J, depending on particular user conditions
Number of impacts:	3 impact points, impact one time per point, every point spaced not less than 500 mm apart
Radius of striking surface:	300 mm

NOTE A different load set can be agreed between customer and supplier.

6.5.5 Repeated bending

a) Family requirements

After the test, there shall be no change in attenuation as defined in IEC 60794-1-1 for optical fibre elements. Under visual examination without magnification, there shall be no damage to the sheath or to the cable elements. The conductor(s) and screen(s) shall be continuous when tested in accordance with IEC 60794-1-403. The withstand voltage of dielectric of current carrying elements shall comply with 6.4.2.

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[3] This mechanical performance conforms to M_3 in MICE classification.

[4] This mechanical performance conforms to M_2 in MICE classification.

[5] This mechanical performance conforms to M_2 in MICE classification.

b) Test conditions

Method:	IEC 60794-1-21, Method E6
Mass of the weight tensile load:	Adequate to assure specimen uniform contact with the mandrel.
Bending radius:	20 × D (unarmoured); 30 × D (armoured)
Number of cycles:	25

6.5.6 Torsion

a) Family requirements

After the test, there shall be no change in attenuation as defined in IEC 60794-1-1 for optical fibre elements. Under visual examination without magnification, there shall be no damage to the sheath or to the cable elements. The conductor(s) and screen(s) shall be continuous when tested in accordance with IEC 60794-1-403. The withstand voltage of dielectric of current carrying elements shall comply with 6.4.2.

b) Test conditions

Method:	IEC 60794-1-21, Method E7
Tension load:	Adequate to assure that the specimen is straight
Length under test:	2 m
Rotating angle:	±180° (unarmoured); ±90° (armoured)

NOTE If the specified twist angle applied to the cable results in a high torsional torque that is not suitable for the cable type, then the rotating angle can be lowered as specified by the manufacturer.

Number of cycles:	10

6.5.7 Bend

a) Family requirements

After the test, there shall be no change in attenuation as defined in IEC 60794-1-1 for optical fibre elements. Under visual examination without magnification, there shall be no damage to the sheath or to the cable elements. The conductor(s) and screen(s) shall be continuous when tested in accordance with IEC 60794-1-403. The withstand voltage of dielectric of current carrying elements shall comply with 6.4.2.

b) Test conditions

Method:	IEC 60794-1-21, Method E11A The default method is Method E11A. For large and/or stiff cables (e.g. where the mandrel diameter required is >20 D), IEC 60794-1-21, Method E11B may be used.
Diameter of mandrel:	20 × D (unarmoured), 40 × D (armoured)
Number of cycles:	3
Number of turns:	4
Test temperature:	Ambient (unless specifically requested otherwise)

6.5.8 Abrasion resistance of cable markings

a) Family requirements

The marking shall be legible at the completion of the test after the number of cycles.

b) Test conditions

Method:	IEC 60794-1-21, Method E2B, Method 2
Force:	5 N
Number of cycles:	Not less than 5

6.6 Environmental requirements

6.6.1 Temperature cycling

a) Family requirements

Attenuation measurements shall be taken in the 1 550 nm region for single-mode fibre and in the 1 300 nm region for multi-mode fibre.

After the test, there shall be no change in attenuation as defined in IEC 60794-1-1 for optical fibre elements.

b) Test conditions

Method:	IEC 60794-1-22, Method F1
Length under test:	Finished cable length, not less than 50 m
High temperature, T_{B2}:	Will be the upper limit of the temperature range of Subclause 5.2
Low temperature, T_{A2}:	Will be the lower limit of the temperature range of Subclause 5.2
Soak time t_1:	Soak time dependent on cable weight according to IEC 60794-1-22, Method F1
Number of cycles:	2

6.6.2 UV resistance

a) Family requirements

After exposure, the average tensile and elongation of the test specimens of sheath shall be a minimum of 70 % of the original value.

b) Test conditions

Method:	IEC 60794-1-22, Method F14

7 Packaging

The cable shall be supplied on reels or in coils suitably protected for transport and the cable ends shall be sealed, if necessary, to prevent the ingress of moisture.

8 Quality assurance

It is the responsibility of the supplier to establish quality assurance by quality control procedures, which ensure that the product meets the requirements of this document. When the customer wishes to specify acceptance tests to other quality procedures, it is essential that an agreement is reached between the customer and the supplier at the time of ordering.

Compliance with specification requirements shall be verified by carrying out tests as required by the relevant family or detailed specification. It is not intended that all tests shall be carried out on every length of the hybrid cables. The frequency of testing shall be agreed between the customer and the supplier.

Quality assessment procedures may be agreed between manufacturer and customer. Current carrying elements shall be tested according to the requirements specified in this document and cited references.

Annex A
(informative)

MICE classification system and its use in this specification

A.1 MICE classification system

As used widely in IEC and ISO/IEC international standards, the MICE classification serves as multi-level specification system for installed cables. It consists of 4 specification groups: Mechanical, Ingress, Climatic and Electromagnetic.

For a given specification there are 3 requirement levels:

1) Light (e.g. office environments)
2) Medium (e.g. light/medium industrial environments)
3) Harsh (e.g. harsh industrial environments)

The following has been adapted from the original text of ISO/IEC 11801-1:2017. See Table A.1.

Table A.1 – Installed cable environments

	1	2	3
Mechanical rating	M_1	M_2	M_3
Ingress rating	I_1	I_2	I_3
Climatic rating	C_1	C_2	C_3
Electromagnetic rating	E_1	E_2	E_3

The definition of a given classification includes the definition of lower classifications, i.e. cables designed to operate under environmental conditions defined by M_2 shall continue to operate under environmental conditions defined by M_1.

Cable environments may be classified by using any combination of the MICE scheme, e.g. $M_1I_2C_3E_1$. The environment is classified in such a way as to allow the selection of suitable components.

The criteria for the MICE classification are based on $M_xI_xC_xE_x$, where "x" can equal 1, 2 or 3 based on the severity of the environment. For example, a typical office space has a minimum requirement of $M_1I_1C_1E_1$.

The classes are defined in Table A.2.

For each M, I, C or E group, the classification of a given environment is determined by the most demanding parameter within the M, I, C or E group. However, the selection of components shall be based on the specific demands of each of the parameters within the M, I, C or E group, which may be less demanding than the overall classification of the group.

A.2 MICE classification and its application in this specification

For FTTA hybrid communication cables, MICE environmental classification has been fully considered. Table A.2 shows MICE classification from ISO/IEC 11801-1:2017 and its application in this specification.

Table A.2 – Details of environmental classification and its application in this specification

	ISO/IEC 11801-1:2017			IEC 62807-3-10
Mechanical	**M_1**	**M_2**	**M_3**	
Shock/bump[a]				
Peak acceleration	40 ms^{-2}	100 ms^{-2}	250 ms^{-2}	NA[e]
Vibration				
Displacement amplitude (2 Hz to 9 Hz)	1,5 mm	7,0 mm	15,0 mm	NA[e]
Acceleration amplitude (9 Hz to 500 Hz)	5 ms^{-2}	20 ms^{-2}	50 ms^{-2}	NA[e]
Tensile strength	[b]	[b]	[b]	See 6.5.2
Crush	45 N over 25 mm (linear) min.	1 100 N over 150 mm (linear) min.	2 200 N over 150 mm (linear) min.	M_2, M_3, See 6.5.3
Impact	1 J	10 J	30 J	See 6.5.4
Bending, flexing and torsion	[b]	[b]	[b]	See Clause 5, 6.5.5 and 6.5.6
Ingress	**I_1**	**I_2**	**I_3**	
Particulate ingress (max. diameter)	12,5 mm	50 µm	50 µm	NA[e]
Immersion	None	Intermittent liquid jet ≤ 12,5 l/min ≥ 6,3 mm jet > 2,5 m distance	Intermittent liquid jet ≤ 12,5 l/min ≥ 6,3 mm jet > 2,5 m distance and immersion (≤ 1 m for ≤ 30 min)	[f]

	ISO/IEC 11801-1:2017			IEC 62807-3-10
Climatic and chemical	**C_1**	**C_2**	**C_3**	
Ambient temperature	−10 °C to +60 °C	−25 °C to +70 °C	−40 °C to +70 °C	C_2, C_3, see Clause 5 and 5.2
Rate of change of temperature	0,1 °C per minute	1,0 °C per minute	3,0 °C per minute	C_3
Humidity	5 % to 85 % (non-condensing)	5 % to 95 % (condensing)	5 % to 95 % (condensing)	d
Solar radiation	700 Wm^{-2}	1 120 Wm^{-2}	1 120 Wm^{-2}	g
Liquid pollution contaminants [c]	Concentration $\times 10^{-6}$	Concentration $\times 10^{-6}$	Concentration $\times 10^{-6}$	
Sodium chloride (salt/sea water)	0	< 0,3	< 0,3	h
Oil (dry-air concentration) (for oil types see [b])	0	< 0,005	< 0,5	h
Sodium stearate (soap)	None	> 5 $\times 10^4$ aqueous non-gelling	> 5 $\times 10^4$ aqueous gelling	h
Detergent	None	ffs	ffs	h
Conductive materials	None	Temporary	Present	h
Gaseous pollution [c] contaminants	Mean / Peak (Concentration $\times 10^{-6}$)	Mean / Peak (Concentration $\times 10^{-6}$)	Mean / Peak (Concentration $\times 10^{-6}$)	
Hydrogen sulphide	< 0,003 / < 0,01	< 0,05 / < 0,5	< 10 / < 50	i
Sulphur dioxide	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 15	i
Sulphur trioxide (ffs)	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 15	i
Chlorine wet (> 50 % humidity)	< 0,000 5 / < 0,001	< 0,005 / < 0,03	< 0,05 / < 0,3	i
Chlorine dry (< 50 % humidity)	< 0,002 / < 0,01	< 0,02 / < 0,1	< 0,2 / < 1,0	i
Hydrogen chloride	– / < 0,06	< 0,06 / < 0,3	< 0,6 / 3,0	i
Hydrogen fluoride	< 0,001 / < 0,005	< 0,01 / < 0,05	< 0,1 / < 1,0	i
Ammonia	< 1 / < 5	< 10 / < 50	< 50 / < 250	i
Oxides of nitrogen	< 0,05 / < 0,1	< 0,5 / < 1	<5 / <10	i
Ozone	< 0,002 / < 0,005	< 0,025 / < 0,05	< 0,1 / < 1	i

	ISO/IEC 11801-1:2017			IEC 62807-3-10
Electromagnetic	**E_1**	**E_2**	**E_3**	
Electrostatic discharge – Contact (0,667 µC)	4 kV	4 kV	4 kV	NA[e]
Electrostatic discharge	8 kV	8 kV	8 kV	NA[e]
Air (0,132 µC)				
Radiated RF – AM	3 V/m at (80 to 1 000) MHz 3 V/m t (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz	3 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz	10 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz	NA[e]
Conducted RF	3 V at 150 kHz to 80 MHz	3 V at 150 kHz to 80 MHz	10 V at 150 kHz to 80 MHz	NA[e]
EFT/B (comms)	500 V	500 V	1 000 V	[d]
Surge (transient ground potential difference) – signal, line to earth	500 V	1 000 V	1 000 V	NA[e]
Magnetic field (50/60 Hz)	1 Am^{-1}	3 Am^{-1}	30 Am^{-1}	NA[e]
Magnetic field (60 Hz to 20 000 Hz)	ffs	ffs	ffs	NA[e]

[a] Bump: the repetitive nature of the shock experienced by the cable shall be taken into account.

[b] This aspect of environmental classification is installation-specific and should be considered in association with IEC 61918 and the appropriate component specification.

[c] A single dimensional characteristic, i.e. concentration 10^{-6}, was chosen to unify limits from different standards.

[d] Under consideration.

[e] It is not applicable for the hybrid cables in this specification.

[f] It is dependent on the cable construction.

[g] Resistance to solar radiation is a property of the sheath material. The severities associated with some common generic materials are indicated in Table A.3.

[h] Resistance to liquid pollution is a property of the sheath material. The severities associated with some common generic materials are indicated in Table A.4.

[i] Resistance to gaseous pollution is a property of the sheath material. The severities associated with some common generic materials are indicated in Table A.5 and Table A.6. The values that appear in tables A.3 to A.6 indicate levels of resistance to climatic phenomena. Values of 1 – 3 correspond to the relevant level of severity in the MICE classification system. A value of 0 indicates no effective resistance to the climatic phenomena described.(from IEC TR 62362:2020)

Table A.3 – Resistance to solar radiation

Material	Natural	Stabilized	With ~2,5 % of active carbon black content
Medium-density polyethylene	0	3	3
Track resistant medium-density polyethylene	0	3	3
High-density polyethylene	0	3	3
Thermoplastic (co)polyester elastomer	0	3	3
Polyvinyl chloride	1	3	3
Polyvinylidene fluoride	1	3	3
Nylon (polyamide 12)	1	3	3
Thermoplastic polyurethane (TPU)	1	3	3

Table A.4 – Liquid pollution

Material	Pollutant				
	Sodium chloride (salt/sea water)	Oil (dry-air concentration)	Sodium stearate (soap)	Detergent	Conductive materials in solution
Low-density polyethylene	3	3	3	3	3
Medium-density polyethylene	3	3	3	3	3
Track resistant medium-density polyethylene	3	3	3	3	3
High-density polyethylene	3	3	3	3	3
Thermoplastic (co)polyester elastomer	3	3	3	3	3
Polyvinyl chloride	2	2	2	2	3
Polyvinylidene fluoride	3	3	3	3	3
Nylon (polyamide 12)	2	2	2	2	3
Thermoplastic polyurethane (TPU)	3	3	3	3	3

Table A.5 – Gaseous pollution resistance

Material	Pollutant				
	Hydrogen sulphide	Sulphur dioxide	Chlorine wet	Chlorine dry	Hydrogen chloride 10 %
Low-density polyethylene	2	2	0	0	2
Medium-density polyethylene	2	2	0	0	2
Track resistant medium-density polyethylene	2	2	0	0	2
High-density polyethylene	2	2	0	0	2
Thermoplastic (co)polyester elastomer	2	2	1	1	0
Polyvinyl chloride	3	3	1	0	3
Polyvinylidene fluoride	3	2	3	3	3
Nylon (polyamide 12)	3	1	0	0	0
Thermoplastic polyurethane (TPU)	3	3	2	2	3

Table A.6 – Gaseous pollution resistance

Material	Pollutant				
	Hydrogen chloride 37 %	Hydrogen fluoride	Ammonia	Oxides of nitrogen	Ozone 100 %
Low-density polyethylene	2	2	3	0	0
Medium-density Polyethylene	2	0	3	0	0
Track resistant medium-density Polyethylene	2	0	3	0	0
High-density polyethylene	2	0	3	0	0
Thermoplastic (co)polyester elastomer	0	0	0	0	0
Polyvinyl chloride	3	2	3	1	1
Polyvinylidene fluoride	3	3	3	2	2
Nylon (polyamide 12)	0	0	3	1	1
Thermoplastic polyurethane (TPU)	3	2	3	3	3

Annex B
(informative)

Some example structures of FTTA hybrid cables

Example structures of hybrid cables are shown in Figure B.1 to Figure B.11.

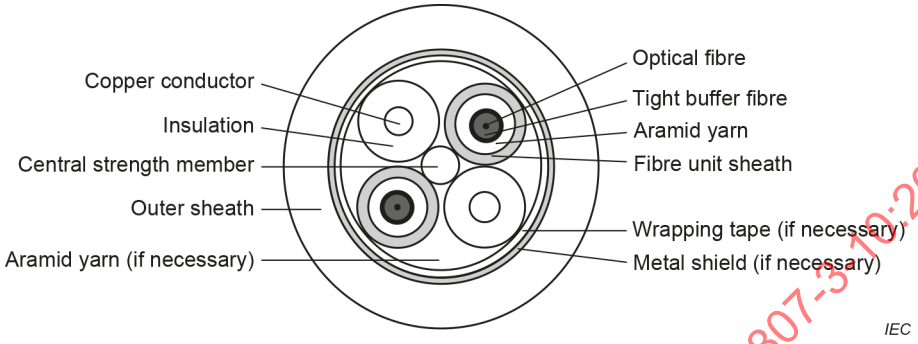

Figure B.1 – Hybrid cable with two optical fibre elements, two current carrying elements and metal shield (2F + 2 × 0,5 mm^2)

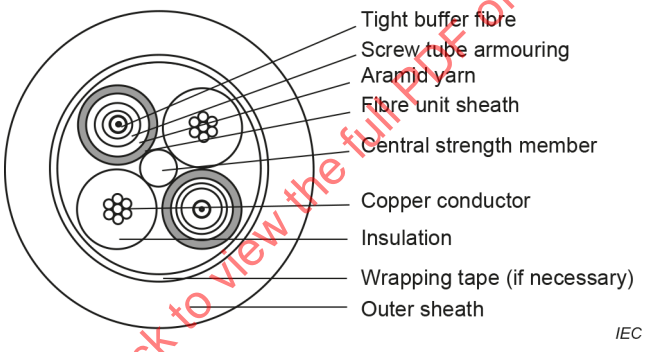

Figure B.2 – Hybrid cable with flexible metal tube armouring (2F + 2 × 1 mm^2)

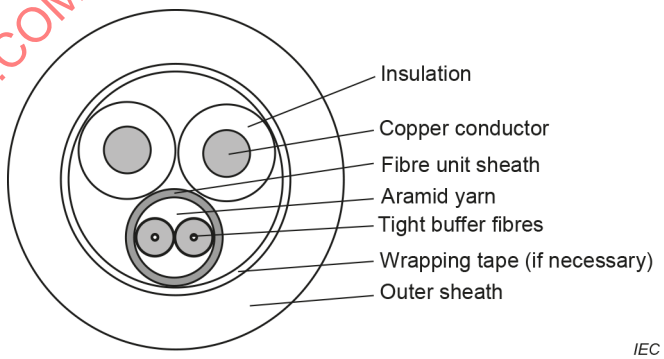

Figure B.3 – Hybrid cable with three elements (2F + 2 × 0,5 mm^2)

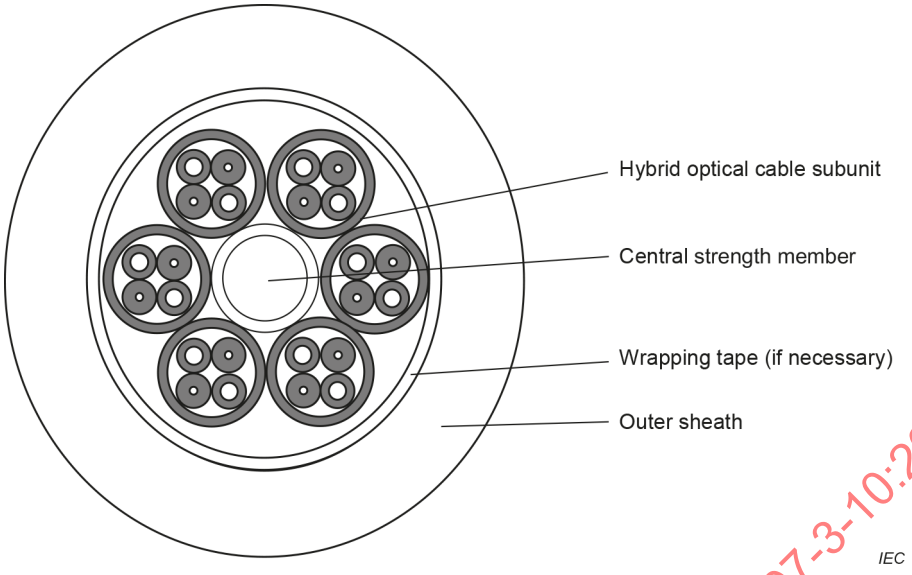

Figure B.4 – Combinational hybrid cable (6 × (2F + 2 × 0,5 mm^2))

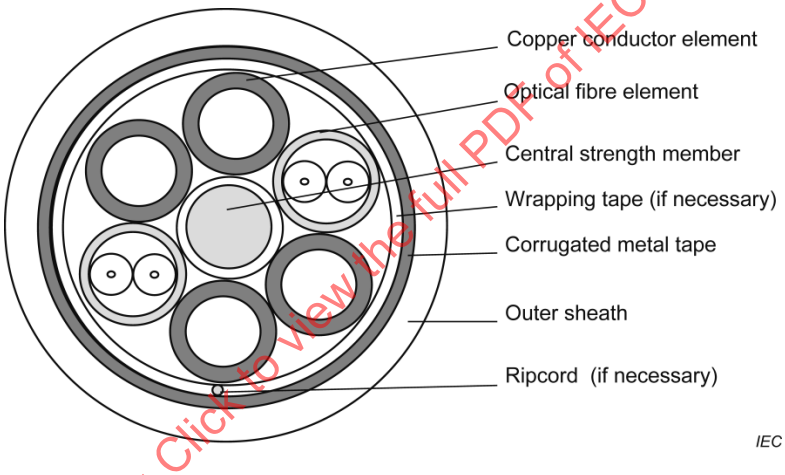

Figure B.5 – Hybrid cable with metal tape armouring (I) (2 × 2F + 4 × 1 mm^2)

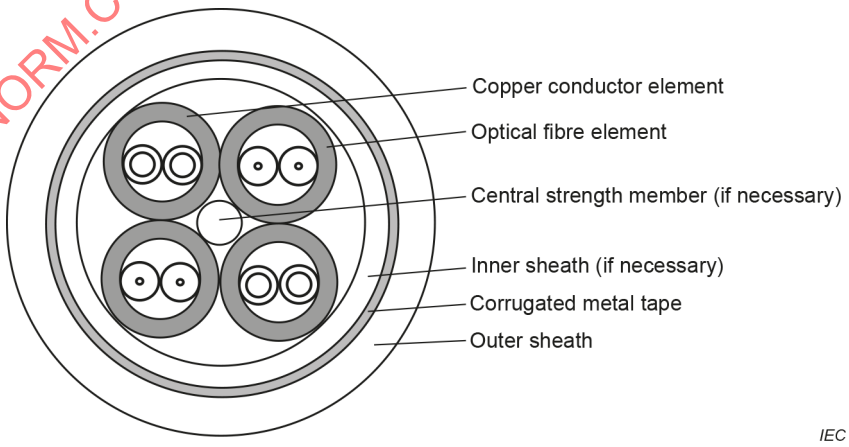

Figure B.6 – Hybrid cable with metal tape armouring (II) (2 × 2F + 2 × 2 × 0,5 mm^2)

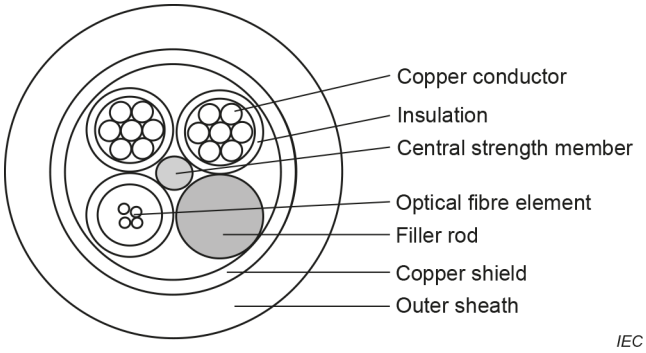

Figure B.7 – Hybrid cable with 2 current carrying elements and 1 optical fibre element

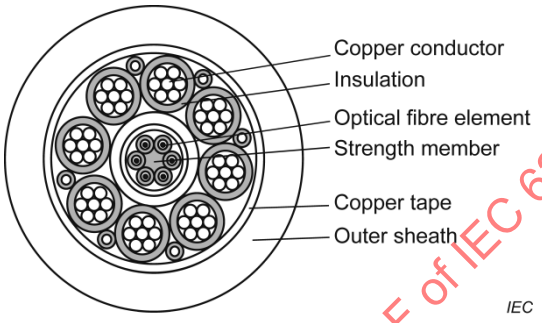

Figure B.8 – Hybrid cable with 8 electrical elements and 6 optical fibre elements

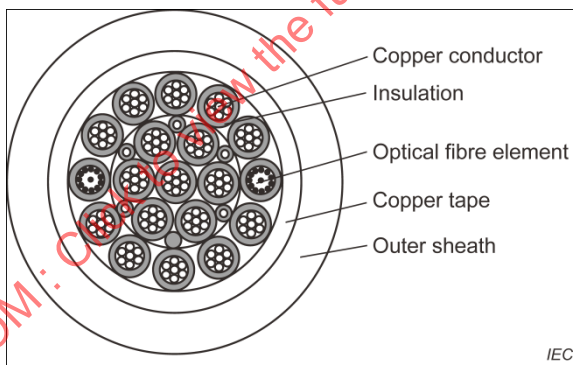

Figure B.9 – Hybrid cable with 16 electrical elements and 2 optical fibre elements

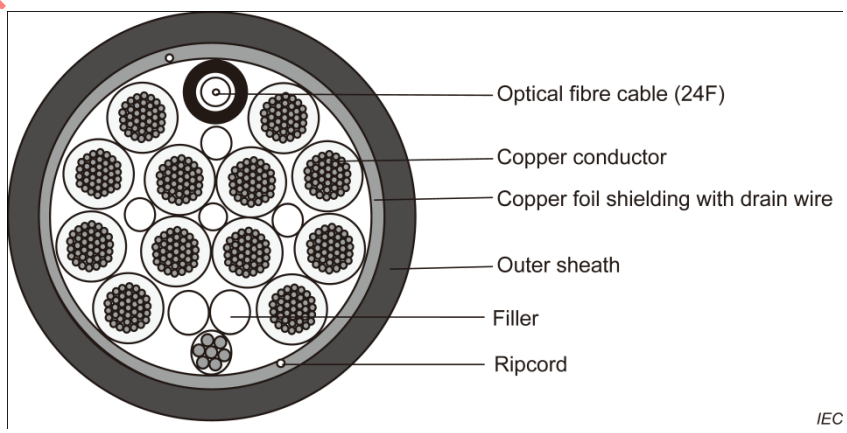

Figure B.10 – Hybrid cable with shielding (1 × 24F + 12 × conductor 6 mm^2 or 16 mm^2)

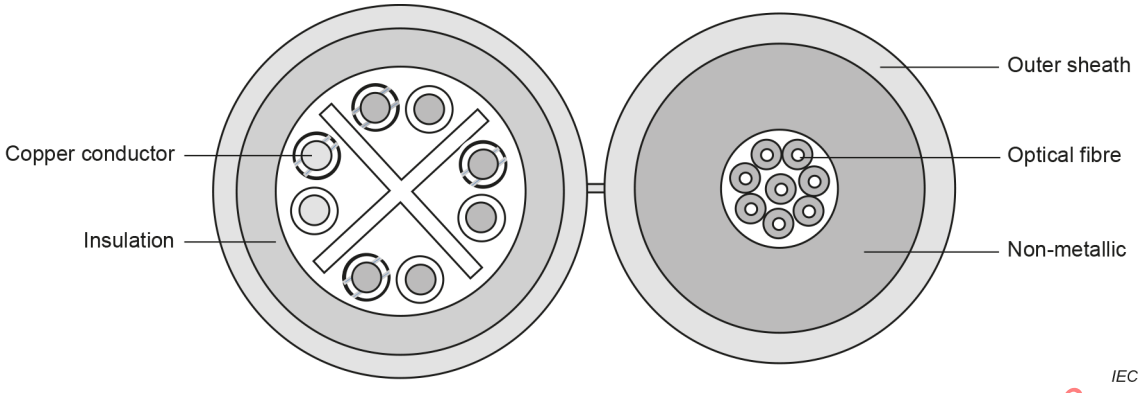

Figure B.11 – Hybrid cable with 8 electrical elements and 1 optical fibre cable

Annex C
(informative)

Blank detail specification and minimum requirements for FTTA hybrid communication cables

Table C.1 – Blank detail specification

Title		
[1] Prepared by		**[2] Document No.:** **Issue:** **Date:**
[3] Available from	**[4]** Generic specification: IEC 62807-1 Sectional specification: IEC 62807-3 Family specification: IEC 62807-3-10	
[5] Additional references:		
[6] Cable description: a) Cable variant: b) Optical fibres elements: c) Current carrying elements: d) Strength member: e) Filler: f) Yarn: g) Tape: h) Ripcord: i) Screen and/or shield: j) Inner sheath: k) Armouring: l) Outer sheath: m) Sheath marking:		
[7] Cable construction:		
Optical fibres element Range of fibre count and type: Modularity: Optical fibres and primary coating: Tight buffer: Independent optical cable: Optical fibre ribbon count:		
Current carrying elements Conductor type Insulation material Number of elements		
Strength member Aramid yarn: Glass fibre reinforced plastic rod: Flexible steel pipe:		

Filler Material: Construction: The number of fillers:
Yarn Material:
Tape Polyester tape: Polyester non-woven tape: Water-blocking tape:
Ripcord Material: Construction:
Screen Single coated metallic tapes (or foils): Metallic braid: Metallic wire:
Inner sheath Material: Min. wall thickness (mm):
Armouring Double coated steel tape:
Outer sheath Material: Min. wall thickness (mm): Maximum outer diameter (d) or width and height (mm):
[8] Engineering information:
Application (outdoor) Long term operational load (T_L): ...N Installation load (T_M): ...N Minimum bending radius for operation: ...mm Minimum bending radius for installation: ...mm Temperature range: Transport and storage: ... °C Installation: ... °C Operation: ... °C Rated voltage: ...V Cable weight: ... kg/km Cable length marking accuracy: $^{-0}_{+1}$ %