

INTERNATIONAL STANDARD

Hybrid communication cables –
Part 3: Outdoor hybrid cables – Sectional specification

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INTERNATIONAL STANDARD

**Hybrid communication cables –
Part 3: Outdoor hybrid cables – Sectional specification**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

HYBRID COMMUNICATION CABLES –

Part 3: Outdoor hybrid cables – Sectional specification

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IEC 62807-3 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/1243/FDIS	46C/1250/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.

A list of all parts in the IEC 62807 series, published under the general title *Hybrid telecommunication 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

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HYBRID COMMUNICATION CABLES –

Part 3: Outdoor hybrid cables – Sectional specification

1 Scope

This part of IEC 62807 is a sectional specification for outdoor hybrid communication cables intended to be used externally in various applications. It specifies terms, definitions, symbols and abbreviated terms, the design and construction, rated values and characteristics, performance requirements and test methods, packaging and quality assurance.

Hybrid cables are designed for networks and customer premises cabling that transmit data, telecommunication, instrumentation, control and signalling services over optical fibres and/or broadband data over coaxial element, wire/pair/quad element and can have the option of supplying electrical current to a remote equipment.

In the IEC 62807 series, the current carrying elements are used only to supply power to the equipment within the communication network. They are not used for electricity distribution or transmission, nor for power supply to domestic appliances. The specific uses are defined in the relevant specification.

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

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 60050-461, *International Electrotechnical Vocabulary (IEV) – Part 461: Electric cables*

IEC 60050-731, *International Electrotechnical Vocabulary (IEV) – Part 731: Optical fibre communication*

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, *Conductors of insulated cables*

IEC 60502-1, *Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) – Part 1: Cables for rated voltages of 1 kV ($U_m = 1,2$ kV) and 3 kV ($U_m = 3,6$ 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 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 60794-3, *Optical fibre cables – Part 3: Outdoor optical fibre cables – Sectional specification*

IEC 60811-501, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 501: Mechanical tests – Tests for determining the mechanical properties of insulating and sheathing compounds*

IEC 61156 (all parts), *Multicore and symmetrical pair/quad cables for digital communications*

IEC 61156-1, *Multicore and symmetrical pair/quad cables for digital communications – Part 1: Generic specification*

IEC 61196 (all parts), *Coaxial communication cables*

IEC 61196-1, *Coaxial communication cables – Part 1: Generic specification – General, definitions and requirements*

IEC 61196-1-102, *Coaxial communication cables – Part 1-102: Electrical test methods – Test for insulation resistance of cable dielectric*

IEC 61196-1-105, *Coaxial communication cables – Part 1-105: Electrical test methods – Test for withstand voltage of cable dielectric*

IEC 61196-1-108, *Coaxial communication cables – Part 1-108: Electrical test methods – Test for characteristic impedance, phase and group delay, electrical length and propagation velocity*

IEC 61196-1-112, *Coaxial communication cables – Part 1-112: Electrical test methods – Test for return loss (uniformity of impedance)*

IEC 61196-1-113, *Coaxial communication cables – Part 1-113: Electrical test methods – Test for attenuation constant*

IEC 61196-1-122, *Coaxial communication cables – Part 1-122: Electrical test methods – Test for cross-talk between coaxial cables*

IEC 61196-1-201, *Coaxial communication cables – Part 1-201: Environmental test methods – Test for cold bend performance of cable*

IEC TR 61931, *Fibre optic – Terminology*

IEC 62153-4-3, *Metallic communication cable test methods – Part 4-3: Electromagnetic Compatibility (EMC) – Surface transfer impedance – Triaxial method*

IEC 62153-4-4, *Metallic communication cable test methods – Part 4-4: Electromagnetic compatibility (EMC) – Test method for measuring of the screening attenuation as up to and above 3 GHz, triaxial method*

IEC 62153-4-9, *Metallic communication cable test methods – Part 4-9: Electromagnetic compatibility (EMC) – Coupling attenuation of screened balanced cables, triaxial method*

IEC 62807-1, *Hybrid telecommunication cables – Part 1: Generic 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, *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 60050-461, IEC 60050-731, IEC 62807-1, IEC 60794-1-1, IEC 61156-1, IEC 61196-1, IEC 60227-1, IEC 62821-1, IEC 60502-1 and IEC TR 61931 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>

3.1

hybrid cable

cable that is composed of at least one optical fibre element and one metallic element such as a coaxial element, wire/pair/quad element or other current carrying elements

3.2

rated voltage

in a cable, reference voltage for which the cable is designed

Note 1 to entry: The rated voltage in an alternating current system is expressed by the combination of two values U_0/U , expressed in volts, where

- U_0 is the RMS value between any insulated phase conductor and the "earth" (metal covering of the cable or the surrounding medium);
- U is the RMS value between two phase conductors of a multicore cable or of a system of a single core cable.

In an alternating current system, the rated voltage of a cable or cord shall be at least equal to the nominal voltage of the system for which it is intended. This condition applies to the values of both U_0 and U .

4 Design and construction

Unless otherwise specified in the detail specification or agreed between customer and supplier, the characteristics and performance of optical fibre elements shall comply with IEC 60794-3, the characteristics and performance of twisted pair/quad elements shall comply with the IEC 61156 series, and the characteristics and performance of internal coaxial elements shall comply with the IEC 61196 series; all current carrying elements shall meet the requirements of the appropriate specification for the rated temperature, power-frequency voltage, and current required, for example, for rating voltage up to and including 450/750 V, the current carrying elements shall meet the requirements of the IEC 60227 series or the IEC 62821 series, for rating voltage of 0,6/1 kV, the current carrying elements shall meet the requirements of IEC 60502-1.

NOTE The current carrying element operating temperature is higher than that of the pair/quad element, restricting the overall operating temperature of the hybrid cable.

A final design containing at least one optical fibre element and one metallic element such as a coaxial element, wire/pair/quad element or other current carrying elements shall be cabled into one overall unit either by an overall sheath or two individual sheaths attached to each other directly or using a separator that can be easily detached.

NOTE The maximum length of a hybrid cable is limited to the attenuation of the communication cable elements in most cases.

5 Rated values and characteristics

The characteristics of hybrid cables and the rated values of those characteristics depend upon the cabled elements contained in the hybrid cable. The appropriate characteristics and rated values, such as the rated temperature ranges for operation, storage and installation, the category of fibre used, the frequency range, the operating current and voltage rating of current carrying elements, the maximum tensile load for installation and the static and dynamic bend radius shall be specified in the detail specification.

6 Performance requirements and test methods

6.1 General

Each element that is a part of a hybrid cable shall meet the requirements of the corresponding specification before being assembled into a hybrid cable. The performances specified in this document are the performance requirements of the finished hybrid cable.

Compliance with the specification requirements of the overall hybrid cable shall be verified by carrying out tests selected from Clause 6. The tests to be applied on cabled optical fibres, coaxial elements, and wire/pair/quad elements or other current carrying elements should be agreed between the customer and supplier. Current carrying elements shall be tested according to the requirements specified in this document and cited references.

When a hybrid cable has current carrying elements of rated voltages including 0,6/1 kV or above, all the elements within the hybrid cable that do not have metallic protection or separation shall be tested to the same voltage as the current carrying elements. Consequently, all metallic parts within the hybrid cable shall be insulated, so that protection is maintained at the same rated voltage. A voltage test for higher ratings may exceed the specified product test withstand voltage.

6.2 Optical requirements for cabled optical fibre

For finished cables, optical fibre elements shall meet the requirements shown in Table 1.

Table 1 – Requirements of optical element

No.	Parameter	Test procedure	Requirements/Remarks
1	Attenuation coefficient	IEC 60793-1-40	The maximum attenuation coefficient shall be in accordance with IEC 60794-1-1 or the detail specification.
2	Cut-off wavelength (Single-mode optical fibre only)	IEC 60793-1-44	The cabled fibre cut-off wavelength (λ_{cc}) shall be less than the operational wavelength and in accordance with IEC 60794-1-1 or the detail specification.
3	Polarization mode dispersion (PMD) (Single-mode optical fibre only)	IEC 60793-1-48	Cabled single-mode fibre PMD shall be in accordance with IEC 60794-1-1 or the detail specification.
4	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 detail specification. During and/or after temperature cycling tests, the change in attenuation of the cable shall be in accordance with the detail specification.

6.3 Electrical and transmission requirements for cabled electrical element

6.3.1 Coaxial element

For finished cables, coaxial elements shall meet the requirements shown in Table 2.

Table 2 – Requirements of coaxial element

No.	Parameter	Test procedure	Requirements/Remarks
1	Inner conductor DC resistance	IEC 60228	The inner conductor DC resistance of each coaxial element in the cable at 20 °C shall be in accordance with the detail specification.
2	Withstand voltage of dielectric	IEC 61196-1-105	There shall be no breakdown or flashover when the test voltage specified in the detail specification is applied between the outer conductor and inner conductor of each coaxial element in the cable.
3	Insulation resistance	IEC 61196-1-102	The insulation resistance between the outer conductor and inner conductor of each coaxial element in the cable shall be in accordance with the detail specification.
4	Mean characteristic impedance	IEC 61196-1-108	The mean characteristic impedance of each coaxial element in the cable shall be in accordance with the detail specification.
5	Attenuation constant	IEC 61196-1-113	The attenuation constant of each coaxial element in the cable shall be in accordance with the detail specification.
6	Return loss	IEC 61196-1-112	The return loss of each coaxial element in the cable shall be in accordance with the detail specification.
7	Surface transfer impedance	IEC 62153-4-3	The surface transfer impedance of each coaxial element in the cable shall be in accordance with the detail specification.
8	Screening attenuation	IEC 62153-4-4	The screening attenuation of each coaxial element in the cable shall be in accordance with the detail specification.
NOTE The voltage withstand of coaxial element will be higher if the current carrying element is rated at 300/500 V to 600/1 000 V.			

6.3.2 Pair/quad element

For finished cables, pair/quad elements shall meet the requirements shown in Table 3.

Table 3 – Requirements of pair/quad element

No.	Parameter	Test procedure	Requirements/Remarks
1	Conductor DC resistance	IEC 60228	The conductor DC resistance of each pair/quad element in the cable at 20 °C shall be in accordance with the detail specification.
2	Resistance unbalance	IEC 61156-1	The resistance unbalance between conductors of a pair and between pairs of each pair/quad element in the cable shall be in accordance with the detail specification.
3	Mutual capacitance	IEC 61156-1	The mutual capacitance between conductors of a pair of each pair/quad element in the cable shall be in accordance with the detail specification.
4	Capacitance unbalance	IEC 61156-1	The pair-to-pair and pair-to-earth capacitance unbalance of each pair/quad element in the cable shall be in accordance with the detail specification.
5	Withstand voltage of dielectric	IEC 61196-1-105	There shall be no breakdown or flashover when the test voltage specified in the detail specification is applied between the insulated conductors and between insulated conductor(s) and screen(s) (if any) of each pair/quad element in the cable.
6	Insulation resistance	IEC 63294	The insulation resistance between the insulated conductors and between insulated conductor(s) and screen(s) (if any) of each pair/quad element in the cable shall be in accordance with the detail specification.
7	Characteristic impedance	IEC 61156-1	The characteristic impedance (either the mean or fitted or input impedance) of each pair/quad element in the cable shall be in accordance with the detail specification.
8	Attenuation	IEC 61156-1	The attenuation of each pair of each pair/quad element in the cable over the frequency range specified shall be in accordance with the detail specification. Test temperature shall be indicated in the detail specification.
9	Attenuation at elevated ambient temperatures	IEC 61156-1	The attenuation of each pair of each pair/quad element in the cable over the frequency range specified shall be in accordance with the detail specification.
10	Near-end crosstalk	IEC 61156-1	The near-end crosstalk of all combinations of pairs of each pair/quad element in the cable over the frequency range specified shall be in accordance with the detail specification.
11	Far-end crosstalk	IEC 61156-1	The far-end crosstalk of all combinations of pairs of each pair/quad element in the cable over the frequency range specified shall be in accordance with the detail specification.
12	Return loss	IEC 61156-1	The return loss of a pair of each pair/quad element in the cable over the frequency range specified shall be in accordance with the detail specification.
13	Surface transfer impedance (if screened)	IEC 62153-4-3	The surface transfer impedance of the cable shall be in accordance with the detail specification.
14	Coupling attenuation	IEC 62153-4-9	The coupling attenuation of each pair/quad element in the cable shall be in accordance with the detail specification.
NOTE The voltage withstand of pair/quad element will be higher if the current carrying element is rated at 300/500 V to 600/1 000 V.			

6.3.3 Current carrying element

For finished cables, current carrying elements shall meet the requirements shown in Table 4.

Table 4 – Requirements of current carrying element

No.	Parameter	Test procedure	Requirements /Remarks
1	Conductor DC resistance	IEC 60228	The conductor DC resistance of each current carrying element in the cable at 20 °C shall be in accordance with the detail specification
2	Withstand voltage of dielectric	IEC 63294 (for rating voltage up to and including 450/750 V) IEC 60502-1 (for 0,6/1 kV)	There shall be no breakdown or flash over when the test voltage specified in the detail specification or the appropriate specification is applied between conductors or between conductor and any other metallic element in the cable.
3	Insulation resistance	IEC 63294 (for rating voltage up to and including 450/750 V) IEC 60502-1 (for 0,6/1 kV)	The insulation resistance between each conductor and other conductors connected or other conductors connected with screen (if any) of each current carrying element in the cable shall be in accordance with the detail specification.

6.3.4 Crosstalk between elements

If applicable, the crosstalk between pair to coax, or coax to coax shall be specified in the detail specification when tested in accordance with IEC 61196-1-122.

6.4 Mechanical requirements of hybrid cable

6.4.1 Tensile

The cable shall be tested in accordance with IEC 60794-1-21, method E1 unless otherwise specified in the detail specification. The cable shall comply with the tensile requirements specified in the detail specification. The strain of the cable elements will generally be the limiting criteria. Depending on the cable design, this may be the copper elongation or the fibre strain. After testing, there shall be no visible cracks, flaws, or other damage in the outer sheath. Each element shall undergo the following additional tests:

- Fibre element: during or after testing, the change in attenuation for each fibre shall comply with No.4 in Table 1.
- Coaxial element: after testing, the attenuation constant and return loss for each coaxial element shall be as specified in the detail specification.
- Pair/quad element: the withstand voltage of the dielectric and return loss shall comply with No.5 and No.12 in Table 3 respectively.
- Current carrying element: the conductor DC resistance and the withstand voltage of the dielectric shall comply with No.1 and No.2 in Table 4 respectively.

6.4.2 Crush

The cable shall be tested in accordance with IEC 60794-1-21, method E3A unless otherwise specified in the detail specification. The cable shall comply with the crush requirements specified in the detail specification. After testing, there shall be no visible cracks, flaws, or other damage in the outer sheath. Each element shall undergo the following additional tests:

- Fibre element: during or after testing, the change in attenuation for each fibre shall comply with No.4 in Table 1.
- Coaxial element: after testing, the attenuation constant and return loss for each coaxial element shall be as specified in the detail specification.
- Pair/quad element: the withstand voltage of the dielectric and return loss shall comply with No.5 and No.12 in Table 3 respectively.
- Current carrying element: the withstand voltage of the dielectric shall comply with No.2 in Table 4.

6.4.3 Impact

The cable shall be tested in accordance with IEC 60794-1-21, method E4 unless otherwise specified in the detail specification. The cable shall comply with the impact requirements specified in the detail specification. After testing, there shall be no visible cracks, flaws, or other damage in the outer sheath. The imprint of the striking surface on the sheath is not considered mechanical damage. Each element shall undergo the following additional tests:

- a) Fibre element: after testing, the change in attenuation for each fibre shall comply with No.4 in Table 1.
- b) Coaxial element: after testing, the attenuation constant and return loss for each coaxial element shall be as specified in the detail specification.
- c) Pair/quad element: the withstand voltage of the dielectric and return loss shall comply with No.5 and No.12 in Table 3 respectively.
- d) Current carrying element: the withstand voltage of the dielectric shall comply with No.2 in Table 4.

6.4.4 Repeated bending

The cable shall be tested in accordance with IEC 60794-1-21, method E6 unless otherwise specified in the detail specification. The cable shall comply with the repeated bending requirements specified in the detail specification. After testing, there shall be no visible cracks, flaws, or other damage in the outer sheath. Each element shall undergo the following additional tests:

- a) Fibre element: during or after testing, the change in attenuation for each fibre shall comply with No.4 in Table 1.
- b) Coaxial element: after testing, the attenuation constant and return loss for each coaxial element shall be as specified in the detail specification.
- c) Pair/quad element: the withstand voltage of the dielectric and return loss shall comply with No.5 and No.12 in Table 3 respectively.
- d) Current carrying element: the withstand voltage of the dielectric shall comply with No.2 in Table 4.

6.4.5 Cold bend

The cable shall be tested in accordance with IEC 61196-1-201, method A or B unless otherwise specified in the detail specification. The cable shall comply with the cold bending requirements specified in the detail specification. After testing, there shall be no visible cracks, flaws, or other damage in the outer sheath.

6.4.6 Torsion

The cable shall be tested in accordance with IEC 60794-1-21, method E7 unless otherwise specified in the detail specification. The cable shall comply with the torsion requirements that are indicated in the detail specification. After testing, there shall be no visible cracks, flaws, or other damage in the outer sheath. Each element shall undergo the following additional tests:

- a) Fibre element: during or after testing, the change in attenuation for each fibre shall comply with No.4 in Table 1.
- b) Coaxial element: after testing, the attenuation constant and return loss for each coaxial element shall be as specified in the detail specification.
- c) Pair/quad element: the withstand voltage of the dielectric and return loss shall comply with No.5 and No.12 in Table 3 respectively.
- d) Current carrying element: the withstand voltage of the dielectric shall comply with No.2 in Table 4.