

INTERNATIONAL STANDARD

**Coaxial communication cables –
Part 10: Sectional specification for semi-rigid cables with fluoropolymer
dielectric**

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dielectric**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COAXIAL COMMUNICATION CABLES –**Part 10: Sectional specification for semi-rigid cables
with fluoropolymer dielectric**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 61196-10 has been prepared by subcommittee 46A: Coaxial cables, of IEC technical committee 46: Cables, wires, waveguides, RF connectors, RF and microwave passive components and accessories. It is an International Standard.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

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

- a) Title was changed to: Sectional specification for semi-rigid cables with fluoropolymer dielectric
- b) 4.3, Dielectric: other fluoropolymer materials (such as FEP, PFA) were added
- c) Table 1 – Distinguishing number was added
- d) Table 2 – Rated temperature was added

- e) New requirements were added as below:
- 8.2.13, Phase stability vs temperature
 - 8.2.14, Phase stability vs bending (for cable with corrugated tube outer conductor)
 - 8.2.15, Corona voltage
 - 8.2.16, RF power
 - 8.2.18, Screening attenuation
 - 8.3.5, Thermal shock
 - 8.3.6, Ultraviolet stability of the sheath
 - 8.4.8, Tensile strength of cable (longitudinal pull)
 - 8.5, Fire performance requirements (applicable to the cable with sheath)
 - 8.5.1, Flame propagation
 - 8.5.2, Halogen acid gas emission
 - 8.5.3, Toxic gas emission
 - 8.5.4, Smoke density
- f) 7.4.8, Thermal cycling was deleted
- g) Annex A: Performance requirements of typical cables was added
- h) Annex B: Requirements for thermal shock was added

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

Draft	Report on voting
46A/1601/FDIS	46A/1606/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 International Standard is to be used in conjunction with IEC 61196-1:2005.

A list of all parts in the IEC 61196 series, published under the general title *Coaxial communication cables*, can be found on the IEC website.

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.

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.

COAXIAL COMMUNICATION CABLES –

Part 10: Sectional specification for semi-rigid cables with fluoropolymer dielectric

1 Scope

This part of IEC 61196 specifies the materials and cable construction for semi-rigid coaxial communication cables with fluoropolymer dielectric, IEC type designation, identification, marking and labelling, standard rating and characteristics, requirements of finished cables, quality assessment, delivery and storage, etc.

This part of IEC 61196 applies to semi-rigid coaxial communication cables with fluoropolymer dielectric and tubular outer conductor. Semi-rigid coaxial communication cables with fluoropolymer dielectric are widely used in mobile communication systems, microwave test equipment, radar, aerospace and other fields.

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 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60332-1-2, *Test on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame*

IEC 60754-1, *Test on gases evolved during combustion of materials from cables – Part 1: Determination of the amount of halogen acid gas*

IEC 61034-2, *Measurement of smoke density of cables burning under defined conditions – Part 2: Test procedure and requirements*

IEC 61169-4, *Radio-frequency connectors – Part 4: RF coaxial connectors with inner diameter of outer conductor 16 mm (0,63 in) with screw lock – Characteristic impedance 50 Ω (type 7-16)*

IEC 61196-1:2005, *Coaxial communication cables – Part 1: Generic specification – General, definitions and requirements*

IEC 61196-1-101, *Coaxial communication cables – Part 1-101: Electrical test methods – Test for conductor d.c. resistance of cable*

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

IEC 61196-1-103, *Coaxial communication cables – Part 1-103: Electrical test methods – Test for capacitance of cable*

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

IEC 61196-1-106, *Coaxial communication cables – Part 1-106: Electrical test methods – Test for withstand voltage of cable sheath*

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 61196-1-110, *Coaxial communication cables – Part 1-110: Electrical test methods – Test for continuity*

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 61196-1-115, *Coaxial communication cables – Part 1-115: Electrical test methods – Test for regularity of impedance (pulse/step function return loss)*

IEC 61196-1-116, *Coaxial communication cables – Part 1-116: Electrical test methods – Test for impedance with time domain reflectometry (TDR)*

IEC 61196-1-119, *Coaxial communication cables – Part 1-119: Electrical test methods – RF average power rating*

IEC 61196-1-126, *Coaxial communication cables – Part 1-126: Electrical test methods – Corona extinction voltage*

IEC 61196-1-212, *Coaxial communication cables – Part 1-212: Environmental test methods – UV stability*

IEC 61196-1-215, *Coaxial communication cables – Part 1-215: Environmental test methods – High temperature cable ageing*

IEC 61196-1-301, *Coaxial communication cables – Part 1-301: Mechanical test methods – Test for ovality*

IEC 61196-1-302, *Coaxial communication cables – Part 1-302: Mechanical test methods – Test for eccentricity*

IEC 61196-1-305:2015, *Coaxial communication cables – Part 1-305: Mechanical test methods – Solderability and resistance to soldering*

IEC 61196-1-313, *Coaxial communication cables – Part 1-313: Mechanical test methods – Adhesion of dielectric and sheath*

IEC 61196-1-314:2015, *Coaxial communication cables – Part 1-314: Mechanical test methods – Test for bending*

IEC 61196-1-316, *Coaxial communication cables – Part 1-316: Mechanical test methods – Test of maximum pulling force of cable*

IEC 61196-1-318:2008, *Coaxial communication cables – Part 1-318: Mechanical test methods – Heat performance tests*

IEC 62037-4, *Passive RF and microwave devices, intermodulation level measurement – Part 4: Measurement of passive intermodulation in coaxial cables*

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 62230, *Electric cables – Spark-test method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61196-1 and the following 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

semi-rigid coaxial communication cable

coaxial line with smooth or corrugated tube outer conductor, not intended to be bent or flexed in service or not intended to be flexed after initial forming

4 Materials and cable construction

4.1 General

The cable construction is composed of inner conductor, insulation, outer conductor and sheath.

4.2 Inner conductor

4.2.1 Conductor material

IEC 61196-1:2005, 4.4.1 applies.

The inner conductor material shall be as stated in the relevant cable detail specification.

4.2.2 Conductor construction

The conductor shall consist of a solid or stranded wire, or corrugated or smooth tube or rifled tube.

In addition, IEC 61196-1:2005, 4.4.4 applies.

The inner conductor diameter shall be stated in the detail specification.

For corrugated inner conductors, peak diameter and root diameter and pitch shall be specified in the detail specification.

The tolerance of the inner conductor shall be specified in the detail specification.

4.3 Dielectric

The dielectric shall be one of the following:

- solid polytetrafluoroethylene (PTFE) or perfluoroalkoxy (PFA) dielectric;
- low-density polytetrafluoroethylene (PTFE) dielectric;
- foamed dielectric fluorinated ethylene propylene (FEP) or perfluoroalkoxy (PFA) dielectric;
- or any other fluoropolymer dielectric materials as stated in the relevant detail specification.

4.4 Outer conductor

The outer conductor shall be a copper or aluminium smooth or corrugated tube with or without coating, or be as stated in the relevant cable detail specification.

The coating material and thickness, if any, shall be stated in the relevant detail specification.

In addition, the requirements of IEC 61196-1:2005, 4.6.1 apply.

For cables with smooth tube out conductors, the diameter and tolerance shall be stated in the detail specification. The recommended outer diameter ratings of outer conductors (approximate the rounded value) are as follows:

0,86 mm (0,034"), 1,19 mm (0,047"), 2,18 mm (0,079"), 3,58 mm (0,141"), 6,35 mm (0,250") or as specified in the detail specification.

For corrugated outer conductors, peak diameter and root diameter and pitch shall be as specified in the detail specification. The recommended outer diameter ratings of outer conductors (approximate the rounded value) is 6 mm (0,236"), or as specified in the detail specification.

The tolerance on the outer conductor shall be specified in the detail specification.

4.5 Sheath (when applicable)

The sheath of a cable is optional and shall be in accordance with IEC 61196-1:2005, 4.7, with the following amendments and additions.

- a) The material of cable sheath shall be specified in the detail specification.
- b) The diameter and minimum thickness and tolerance of the sheath shall be as stated in the detail specification.
- c) For cables intended for outdoor use or exposed to sunlight, the cable shall pass the UV stability test according to IEC 61196-1-212.

5 Type name and identification of cable

5.1 Type

The type of cable consists of nominal characteristic impedance, the hyphen, and the outer diameter rating of outer conductor. The specific names are as follows:

- a) The nominal characteristic impedance, giving the nominal characteristic impedance of the cable in ohms, e.g. 50.
- b) The hyphen is an interval.
- c) The outer diameter ratings (the approximate outer diameter) of the outer conductor in mm; when needed, the outer diameter ratings of the outer conductor in inches may be given in brackets.

EXAMPLE 50-3(0,141") is the cable type with nominal characteristic impedance of 50 Ω and the outer diameter rating of outer conductor is 3,58 mm (0,141") and 50-6 (0,250") is the cable type with nominal characteristic impedance of 50 Ω and the outer diameter rating of outer conductor is 6,35 mm (0,250").

5.2 Variants

The variant of cables should be identified by the following:

- a) Type name: see 5.1.
- b) Distinguishing number: it should consist of three digital characters (XYZ) which distinguishes the different construction and material of the various cables.

The "X" specifies the material type of the inner conductor.

The "Y" specifies the material type and structure of the dielectric.

The "Z" specifies the material type and structure of outer conductor.

The details are listed in Table 1.

Table 1 – Distinguishing number

"X"	Material of the inner Conductor	"Y"	Material and structure of dielectric	"Z"	Material and structure of outer conductor
No Entry	Silver plated copper wire	No Entry	PTFE	No Entry	Smooth copper tube
SS	Silver plated copper clad steel wire	L	Low-density PTFE	AT	Smooth aluminium tube
SA	Silver plated copper clad aluminium wire	UL	Ultra-low-density PTFE	H	Helically corrugated copper tube
		FF	Foamed FEP		
		FP	Foamed PFA		
		P	PFA		

5.3 Cable marking

The cable marking consists of cable type, variants and IEC standard number, as shown in Figure 1.

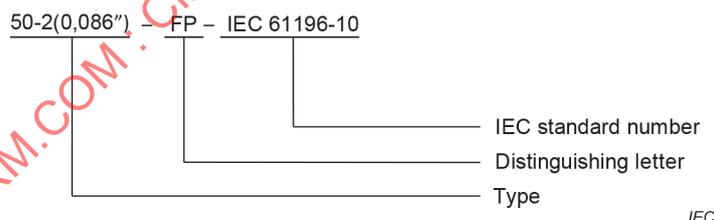


Figure 1 – Cable marking

EXAMPLE 50-2(0,086'')-FP-IEC 61196-10 indicates that the characteristic impedance is 50 Ω, the outer diameter rating of outer conductor is 2,18 mm (0,086''), silver-plated copper inner conductor, foamed PFA dielectric, smooth copper tube, which conform to IEC 61196-10.

6 Identification, marking and labelling

6.1 Cable identification

IEC 61196-1:2005, 6.1 applies.

6.2 Cable marking

The cable marking shall be applied to the sheath. The marking shall consist of cable marking given in 5.3 and/or the manufacturer's designated marking when specified in the detail specification.

For unsheathed cables, the cable marking can be applied on the outer conductor or specified in the detail specification.

6.3 Labelling

Labelling shall be provided in accordance with IEC 61196-1:2005, 6.3 and the detail specification.

7 Standard rating and characteristics

7.1 Nominal characteristic impedance

The nominal characteristic impedance shall be 50 Ω or as specified in the detail specification.

7.2 Rated temperature range

The rated temperature ranges are given in Table 2 or as specified in the detail specification.

Table 2 – Rated temperature

Parameter	No sheath °C	PVC Sheath °C	PVDF Sheath °C	LSZH Sheath °C
Operational temperature range	-55 to 125 ^a	-40 to 75	-40 to 125	-25 to 70
Storage temperature range	-55 to 125 ^b	-40 to 75	-40 to 125	-25 to 70
Installation temperature range	-10 to 40	-30 to 60	-40 to 60	-15 to 60
^a The operational temperature range of type 50-1(0,034") and 50-6(0,250") is -55 °C to 105 °C. ^b The storage temperature range of type 50-1(0,034") and 50-6(0,250") is -55 °C to 105 °C.				

7.3 Operating frequency

The operating frequency range is specified in the detailed specification. The maximum operating frequency of typical cables is given in Annex A.

7.4 Average and peak power

Average and peak power shall be specified in the detail specification.

7.5 Bending radius

The minimum bending radius is specified in the detail specification. The minimum bending radius of typical cables is given in Annex A.

8 Requirements of finished cables

8.1 General

For finished cables, the requirements given below shall apply when they are tested in accordance with the IEC 61196-1 series or this clause.

Unless otherwise specified, all measurements shall be carried out under standard atmospheric conditions for testing in accordance with IEC 60068-1:2013, Clause 5.

Applicable test methods shall be in accordance with IEC 61196-1-*n* and other test methods specified in the present document.

8.2 Electrical requirements

Electrical measurements are given in Table 3.

Table 3 – Electrical requirements

Subclause	Test procedure	Parameter	Requirements/Remarks
8.2.1	IEC 61196-1-110	Continuity	Inner conductor shall be continuous. Outer conductor shall be continuous.
8.2.2	IEC 61196-1-101	Inner and outer conductor direct current resistance	Value in accordance with the detail specification
8.2.3	IEC 61196-1-105	Withstand voltage of dielectric	Value in accordance with the detail specification.
8.2.4	IEC 61196-1-106 (or IEC 62230)	Withstand voltage of sheath (or spark test) ^a	Unless otherwise specified in the detail specification, the following test voltage shall be applied for one minute. 2 kV RMS for sheath thickness over 0,5 mm and less than 0,8 mm. 3 kV RMS for sheath thickness over 0,8 mm and less than 1,0 mm. 5 kV RMS for sheath thickness over 1,0 mm.
8.2.5	IEC 61196-1-102	Insulation resistance	$\geq 10^3$ M Ω · km
8.2.6	IEC 61196-1-103	Capacitance	Value in accordance with the relevant detail specification. The values of typical cables are given in Annex A.
8.2.7	IEC 61196-1-116	Characteristic impedance	Value in accordance with the relevant detail specification, typical values are 50 Ω , 75 Ω .
8.2.8	IEC 61196-1-115	Regularity of impedance	When required, perform on both ends of tested cable Regularity \geq 40 dB or resp. \leq 1 % Test procedure: IEC 61196-1-115, (time domain) or IEC 62153-1-1, (transformation from frequency domain into time domain by IDFT)
8.2.9	IEC 61196-1-108	Propagation velocity	When required, value in accordance with the relevant detail specification. The values of typical cables are given in Annex A.
8.2.10	IEC 61196-1-112	Return loss	Specimen length: \geq 2 m, the return loss should meet the following requirements in the actual working frequency band of the cable or according to the relevant detailed specification \geq 23,1 dB (10 MHz to 6 000 MHz) \geq 20,8 dB (6 000 MHz to 12 000 MHz) \geq 19,1 dB (12 000 MHz to 18 000 MHz) \geq 16,5 dB (18 000 MHz to 26 500 MHz) \geq 15,6 dB (26 500 MHz to 40 000 MHz)
8.2.11	IEC 61196-1-113	Attenuation constant	Value in accordance with the detail specification. The values of typical cables are given in Annex A.
8.2.12	IEC 61196-1-215	Attenuation stability	When required, see 8.3.1
8.2.13	IEC 61196-1-111	Phase stability vs temperature	When applicable, value in accordance with the relevant detail specification The values of typical cables are given in Annex A.

Subclause	Test procedure	Parameter	Requirements/Remarks
8.2.14	IEC 61196-1-111	Phase stability vs bending (for cable with corrugated tube outer conductor)	When applicable, value in accordance with the relevant detail specification
8.2.15	IEC 61196-1-126	Corona voltage	When required, value in accordance with the relevant detail specification
8.2.16	IEC 61196-1-119	RF power	When required, value in accordance with the relevant detail specification
8.2.17	IEC 62037-4	Passive intermodulation (IM3)	When required, this test is only applicable to the cable with characteristic impedance of 50 Ω. Both ends of the specimen should be attached with suitable RF connectors (recommended type 7-16 connectors, according to IEC 61169-4). PIM should be performed under the minimum bending radius. Passive Intermodulation is better than –158dBc Input power: 2 × 20 W Test frequency: 700 MHz, 900 MHz, 1 800 MHz, 2 100 MHz, 2 600 MHz
8.2.18	IEC 62153-4-4	Screening attenuation	When required, better than –110dB (0,5 GHz to 3 GHz) or value in accordance with the relevant detail specification.

^a Applicable to the cable with sheath

8.3 Environmental requirements

Environmental requirements are given in Table 4.

Table 4 – Environmental requirements

Subclause	Test procedure	Parameter	Requirements/remarks
8.3.1	IEC 61196-1-215	Ageing	When required, two samples should be used for the test the temperature value is the maximum operational temperature rating of the cable Duration: 168 h or as specified in detail specification. Requirements after ageing and cooling down to standard atmospheric conditions a) The displacement of the cable elements shall comply with that indicated in the relevant cable specification. b) The return loss shall remain within the specified limits in 8.2.10. c) The attenuation shall remain within the specified limits in 8.2.11. d) No cracks, flaws or other damage in the cable surface.
8.3.2	IEC 61196-1-318:2008, Clause 6	Heat behaviour	For sheathed cable, the sheath shall be stripped off. Length of the cable under test: 300 mm to 350 mm Temperature of the heating: 175 °C ± 5 °C, or as specified in detail specification Neither cracks nor longitudinal splits shall be visible in the outer conductor. Nor shall the dielectric core protrude from the ends of the test specimen.

Subclause	Test procedure	Parameter	Requirements/remarks
8.3.3	IEC 61196-1-305:2015, Clause 4	Solderability	The surface of tubular outer conductor corresponding to the immersed length shall be correctly tinned, i.e. more than 95 % of this surface shall be wetted by solder, the spots and marks of soldering shall not be concentrated in one area, and they shall not exceed 5 % of the immersed surface.
8.3.4	IEC 61196-1-305:2015, Clause 5	Resistance to soldering	When applicable, value in accordance with the relevant detail specification
8.3.5	Annex B	Thermal shock	The test temperature is specified in detail specification Duration: see Annex B or as specified in detail specification. Cycles: 5 or as specified in detail specification. Requirements: a) The displacement of the cable elements shall comply with that indicated in the relevant cable specification. b) The return loss shall remain within the specified limits in 8.2.10. c) The attenuation change shall be in accordance with the relevant detail specification. d) No cracks, flaws or other damage in the cable surface.
8.3.6	IEC 61196-1-212	Ultraviolet stability of the sheath	When applicable (see 4.5), test procedure shall be specified in detail specification Requirements: – After 720 h, changes in elongation $\leq \pm 20 \%$ – After 720 h, changes in tensile strength $\leq \pm 20 \%$ – No visual cracks

8.4 Mechanical requirements

Mechanical requirements are given in Table 5.

Table 5 – Mechanical requirements

No.	Test methods	Parameter	Requirements/remarks
8.4.1	4.2 of IEC 61196-1:2005	Visual examination	The sheath shall be free of cracks, splits, irregularities, and imbedded foreign material. The outer conductor shall be free of black spots or cracks.
8.4.2	4.3 of IEC 61196-1:2005	Dimensional examination	Value in accordance with the detail specification
8.4.3	IEC 61196-1-301	Ovality of inner conductor	When applicable, $\leq 7 \%$, or value in accordance with the relevant detail specification
8.4.4	IEC 61196-1-302	Eccentricity of dielectric	When applicable, $\leq 10 \%$, or value in accordance with the relevant detail specification
8.4.5	IEC 61196-1-301	Ovality of sheath	When applicable, $\leq 7 \%$, or value in accordance with the relevant detail specification
8.4.6	IEC 61196-1-313	Adhesion of dielectric	Value in accordance with the detail specification. a) Test temperature: $20 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$ b) Specimen length (L) = 50 mm

No.	Test methods	Parameter	Requirements/remarks
8.4.7	IEC 61196-1-314	Cable bending	<p>For smooth tube outer conductors, the bending test shall be in accordance with IEC 61196-1-314:2015, 4.3.2, procedure 1, 1 cycle, bending radius in accordance with the relevant detail specification.</p> <p>For corrugated tube outer conductors, the bending test shall be in accordance with IEC 61196-1-314:2015, Clause 5, repeated bending, the number of cycles, mass of weight, bending radius in accordance with the relevant detail specification.</p> <p>Requirements:</p> <ul style="list-style-type: none"> Attenuation change shall be in accordance with the relevant detail specification The return loss shall remain within the specified limits in 8.2.10. No physical damage in cable. <p>When applicable, the PIM shall remain within the specified limits in 8.2.17</p>
8.4.8	IEC 61196-1-316	Tensile strength of cable (longitudinal pull)	<p>When required, the maximum tension applied shall be greater than or equal to the cable weight of 100 m or be specified in the detail specification.</p> <p>Requirements:</p> <ul style="list-style-type: none"> The characteristic impedance shall remain within the specified limits in 8.2.7. No physical damage in cable.

8.5 Fire performance requirements (applicable to cables with sheaths)

When users have requirements in terms of fire performance, cables with sheaths should meet the requirements of Table 6. When intended to be installed in constructions, these cables can fall under the requirements of local, regional or governmental regulations for fire and safety standards.

Table 6 – Fire performance requirements

Subclause	Test procedure	Parameter	Requirements/Remarks
8.5.1	IEC 60332-1-2	Flame propagation	The distance between the upper carbonization point and the lower edge of the upper support is greater than 50 mm, and the distance between the lower carbonization point and the lower edge of the upper support is not greater than 540 mm, or as specified in the detail specification.
8.5.2	IEC 60754-1	Halogen acid gas emission	≤ 5 mg/g or as specified in the detail specification
8.5.3	Under consideration	Toxic gas emission	When required, according to the detail specification.
8.5.4	IEC 61034-2	Smoke density	Transmittance ≥ 60 % or as specified in the detail specification

9 Quality assessment

Quality assessment shall be in accordance with IEC 61196-1-1 or Annex C.

10 Delivery and storage

Delivery of cables shall be in accordance with IEC 61196-1:2005, Clause 9.

Annex A (normative)

Performance requirements of typical cables

A.1 Performance requirements

Some performance requirements of typical cables are given in Table A.1. The attenuation values are specified in Clause A.2.

Table A.1 – Some performance requirements of typical cables

Typical cable Variants	Maximum operating frequency GHz	Cut-off frequency GHz	Propagation velocity %	Capacitance pF	Bending radius mm	Phase stability vs Temperature PPM
50-1(0,034")	40	155	≥ 68,5	≤ 105	3,2	—
50-1(0,047")	40	108	≥ 68,5	≤ 105	3,2	—
50-2(0,086")	40	61	≥ 68,5	≤ 105	3,2	—
50-2(0,086")-L	40	65	≥ 75	≤ 91	6,4	—
50-2(0,086")-UL	40	71	≥ 80	≤ 85	9,5	≤ 750
50-2(0,086")-FF	40	67	≥ 79	≤ 85	3,2	≤ 850
50-2(0,086")-FP	40	67	≥ 79	≤ 85	3,2	≤ 850
50-3(0,141")	20	34	≥ 68,5	≤ 105	6,4	—
50-3(0,141")-L	26,5	37	≥ 75	≤ 91	12,7	—
50-3(0,141")-UL	33	40	≥ 80	≤ 85	12,7	≤ 750
50-3(0,141")-FF	33	39	≥ 80	≤ 85	12,7	≤ 850
50-3(0,141")-FP	33	39	≥ 80	≤ 85	12,7	≤ 850
50-6(0,250")	18	19	≥ 68,5	≤ 105	19,1	—
50-6(0,250")-FF-H	12	23	≥ 80	≤ 85	25,4	≤ 700
50-6(0,250")-FP-H	12	23	≥ 80	≤ 85	25,4	≤ 700

NOTE The cut-off frequency is calculated based on the corresponding propagation speed. The change of the product structure dimension in the manufacturing process will also affect the change of the cut-off frequency.

A.2 Attenuation

Maximum attenuation values of the typical cables can be calculated as shown in Formulas (A.1).

$$\alpha = A \times \sqrt{f} + B \times f \tag{A.1}$$

Where

α is the attenuation at 20 °C, in dB/m,

A, B are given in Table A.1,

f is the frequency, in GHz.

Values at typical frequencies are given in Table A.2.

Table A.2 – Maximum attenuation

Typical cable Variants	A	B	Maximum attenuation at typical frequencies							
			dB/m							
			0,5 GHz	1 GHz	6 GHz	12 GHz	18 GHz	26,5 GHz	33 GHz	40 GHz
50-1(0,034")	1,914 1	0,028 7	1,37	1,94	4,86	6,98	8,64	10,61	11,94	13,25
50-1(0,047")	1,282 1	0,023 2	0,92	1,31	3,28	4,72	5,86	7,21	8,13	9,04
50-2(0,086")	0,676 5	0,023 5	0,49	0,70	1,80	2,63	3,29	4,11	4,66	5,22
50-2(0,086")-L	0,591 0	0,009 4	0,42	0,60	1,50	2,16	2,68	3,29	3,71	4,11
50-2(0,086")-UL	0,580 0	0,005 0	0,41	0,59	1,45	2,07	2,55	3,12	3,50	3,87
50-2(0,086")-FF	0,617 5	0,024 5	0,45	0,64	1,66	2,43	3,06	3,83	4,36	4,89
50-2(0,086")-FP	0,617 5	0,024 5	0,45	0,64	1,66	2,43	3,06	3,83	4,36	4,89
50-3(0,141")	0,360 5	0,029 5	0,27	0,39	1,06	1,60	2,06	2,64	3,04	—
50-3(0,141")-L	0,330 6	0,009 4	0,24	0,34	0,87	1,26	1,57	1,95	2,21	—
50-3(0,141")-UL	0,315 0	0,005 0	0,23	0,32	0,80	1,15	1,43	1,75	1,97	—
50-3(0,141")-FF	0,321 8	0,023 2	0,24	0,35	0,93	1,39	1,78	2,27	2,61	—
50-3(0,141")-FP	0,321 8	0,023 2	0,24	0,35	0,93	1,39	1,78	2,27	2,61	—
50-6(0,250")	0,226 8	0,023 2	0,17	0,25	0,69	1,06	1,38	—	—	—
50-6(0,250")-FF-H	0,203 8	0,022 6	0,16	0,23	0,63	0,98	—	—	—	—
50-6(0,250")-FP-H	0,203 8	0,022 6	0,16	0,23	0,63	0,98	—	—	—	—

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Annex B (normative)

Thermal shock

B.1 General

This test is used to evaluate the transmission and mechanical performance of coaxial cables under the effects of thermal shock.

After the test, the transmission performance (such as insertion loss, return loss) and the mechanical performance (such as the mechanical movement of dielectric related to the inner conductor) shall be specified in relevant detail specification.

B.2 Test samples

The cable length shall be 3 m or as specified in the detail specification.

At least two test samples should be used for the test as specified below:

- a) one test sample terminated with connectors that can be used to measure the transmission performance;
- b) one piece of cable with its ends cut flush that can be used to test the mechanical performance.

If the test samples have to be coiled to fit in the chamber, they should be loosely coiled at the minimum bend radius with the end of the cable being straight.

B.3 Test equipment

The following test equipment or equivalent equipment shall be used:

- a) Environmental chambers: a system of sufficient thermal capacity shall be used to change ambient chamber conditions to meet the test requirements. If applicable, the required thermal capacity of the environmental chambers shall be specified in the relevant detail specification.
- b) A vector network analyzer or other suitable equipment.

B.4 Procedure

B.4.1 Initial measurements

The initial transmission and mechanical performance of the test samples shall be measured in accordance with the relevant detail specification.

B.4.2 Thermal shock

Test samples shall be placed into the environmental chamber so that there is substantially no obstruction to the flow of air across and around the specimen. The specimen shall be subjected to the specified test condition of Table B.1. One cycle consists of step 1 to step 4. Unless otherwise specified, 5 cycles shall be conducted.

Test samples shall not be subjected to forced circulating air during the test. the effective total transfer time from the low temperature to the high temperature, or the reverse, shall not exceed 5 minutes. Direct heat conduction to the specimen should be avoided.

Table B.1 – Test condition

Step	Test condition	Exposure time
1	Low temperature	See Table B.2
2 ^a	20 ⁺¹⁰ ₋₅	≤ 5 min
3	High temperature	See Table B.2
4 ^a	20 ⁺¹⁰ ₋₅	≤ 5 min
^a For environmental chambers that can transfer the temperature from low temperature to high temperature without moving the test samples, steps 2 and 4 are not applicable.		

Table B.2 – Exposure time at temperature extremes

Weight of specimen	Exposure time h
≤ 28 g	1/4
> 28 g to ≤ 136 g	1/2
> 136 g to ≤ 1,36 kg	1
> 1,36 kg to ≤ 13,6 kg	2
> 13,6 kg to ≤ 136 kg	4
> 136 kg	8

B.4.3 Final measurements

After the test, the test samples shall be removed from the chamber and allowed to stabilize at ambient room temperature. After reaching ambient room temperature, the transmission and mechanical performance shall be measured in accordance with the relevant detail specification.

Annex C (informative)

Quality assessment

C.1 General

Quality assessment procedures may be agreed between manufacturer and customer.

Annex C provides guidance and details of the general procedures for quality conformance inspection, qualification approval and capability approval. It includes information on related documents and procedures, standardized test methods, a basic schedule for tests relating to quality conformance inspection and qualification approval.

C.2 Qualification approval and its maintenance

C.2.1 Qualification approval

C.2.1.1 Sample

The sample of each cable type submitted for qualification inspection shall be of sufficient length to perform all the applicable tests in Table C.1.

C.2.1.2 Inspection routine

The samples shall be subjected to the inspections specified in Table C.1. The entire sample shall be subjected to the inspections of group I. The specimen length shall be cut from each sample as required, and subjected to inspections of group II.

C.2.1.3 Failure

One or more failures shall be cause for refusal to grant qualification approval.

C.2.1.4 Maintenance of qualification approval

This shall consist of three consecutive lots passing test groups A specified in C.2.3.1.6 and B specified in C.2.3.1.7, and followed by a selection of test samples from the lots, as appropriate. These test samples shall successfully pass the periodic inspection (test groups C) specified in C.2.3.2.

C.2.2 Capability approval

When specified in the relevant detail specifications, capability approval shall be in accordance with IEC 61196-1-1.

C.2.3 Quality conformance inspection

C.2.3.1 Inspection of product for delivery

C.2.3.1.1 General

Inspection of product for delivery shall consist of test groups A and B on a lot-by-lot basis.

Table C.1 – Qualification inspection

Parameter	Requirement subclause	Test methods	Number of test samples to be tested
Group I			
Visual examination	8.4.1	IEC 61196-1:2005, 4.2	Entire sample
Dimensional examination	8.4.2	IEC 61196-1:2005, 4.3	Entire sample
Continuity	8.2.1	IEC 61196-1-110	Entire
Inner and outer conductor direct current resistance	8.2.2	IEC 61196-1-101	Entire
Withstand voltage of dielectric	8.2.3	IEC 61196-1-105	Entire
Withstand voltage of sheath (or spark test) ^a	8.2.4	IEC 61196-1-106 (or IEC 62230)	Entire
Insulation resistance	8.2.5	IEC 61196-1-102	Entire
Group II			
Ovality of inner conductor ^c	8.4.3	IEC 61196-1-301	2
Eccentricity of dielectric ^c	8.4.4	IEC 61196-1-302	2
Ovality of sheath ^{a c}	8.4.5	IEC 61196-1-301	2
Capacitance	8.2.6	IEC 61196-1-103	1
Characteristic impedance	8.2.7	IEC 61196-1-116	1
Regularity of impedance ^b	8.2.8	IEC 61196-1-115	1
Propagation velocity ^b	8.2.9	IEC 61196-1-108	1
Return loss	8.2.10	IEC 61196-1-112	2
Attenuation constant	8.2.11	IEC 61196-1-113	
Attenuation stability ^b	8.2.12	IEC 61196-1-215	2
Phase stability vs Temperature ^c	8.2.13	IEC 61196-1-111	2
Phase stability vs bending (for cable with corrugated tube outer conductor) ^c	8.2.14	IEC 61196-1-111	2
Corona voltage ^b	8.2.15	IEC 61196-1-126	1
RF power ^b	8.2.16	IEC 61196-1-119	1
Passive Intermodulation(IM3) ^{b c}	8.2.17	IEC 62037-4	2
Screening attenuation ^b	8.2.18	IEC 62153-4-4	2
Adhesion of dielectric	8.4.6	IEC 61196-1-313	3
Cable bending	8.4.7	IEC 61196-1-314	3
Tensile strength of cable (longitudinal pull) ^b	8.4.8	IEC 61196-1-316	1
Ageing ^b	8.3.1	IEC 61196-1-215	2
Heat behaviour	8.3.2	IEC 61196-1-318:2008, Clause 6	3
Solderability	8.3.3	IEC 61196-1-305:2015, Clause 4	1
Resistance to soldering ^c	8.3.4	IEC 61196-1-305:2015, Clause 5	1
Thermal shock	8.3.5	Annex B	2
Ultraviolet stability of the sheath ^{a c}	8.3.6	IEC 61196-1-212	1
Flame propagation ^{a b}	8.5.1	IEC 60332-1-2	1
Halogen acid gas emission ^{a b}	8.5.2	IEC 60754-1	1
Toxic gas emission ^{a b}	8.5.3	Under consideration	Under consideration
Smoke density ^{a b}	8.5.4	IEC 61034-2	1
^a Applicable to cable with sheath.			
^b When required.			
^c When applicable			

C.2.3.1.2 Unit of product

A unit of product shall be one coil or one packed cable with the same type designation.

C.2.3.1.3 Inspection lot

The inspection lot shall consist of the required number of units of the product, covered by same detail specification, offered for inspection at one time. All the units of the product in the inspection lot submitted shall have been produced during the same production period with the same materials and processes.

C.2.3.1.4 Sample unit

A sample unit shall be a unit of the product selected at random from the inspection lot without regard to quality.

C.2.3.1.5 Specimen

A specimen shall be an individual length of cable cut from the sample unit.

C.2.3.1.6 Test groups A

Group A inspection shall consist of the examinations and tests specified in Table C.2 in the order shown and shall be performed on 100 % of cables submitted.

An inspection lot is rejected if more than 10 % of products fail any test in the test group. The defective units shall be sorted out if not more than 10 % of products fail any test in the test group.

C.2.3.1.7 Test groups B

Group B inspection shall consist of the examinations and tests specified in Table C.2 in the order shown. The sampling plan shall be in accordance with ISO 2859-1 for general inspection level II. The acceptance quality level (AQL) shall be as specified in Table C.2.

If one or more defects are found, the lot shall be screened for that particular defect(s) and defects removed. A new sample of product shall again be submitted to all group B tests with the same sampling plan. If any defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

C.2.3.2 Periodic inspection

This shall consist of test groups C in Table C.2 on a periodic basis. Group C inspection shall be made on three sample units selected from inspection lots that have passed the groups A and B inspections every 12 months.

No failures shall be permitted for group C inspection.