

INTERNATIONAL STANDARD

**Coaxial communication cables –
Part 9: Sectional specification for RF flexible cables**

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**Coaxial communication cables –
Part 9: Sectional specification for RF flexible cables**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COAXIAL COMMUNICATION CABLES –

Part 9: Sectional specification for RF flexible cables

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International Standard IEC 61196-9 has been prepared by subcommittee 46A: Coaxial cables, of IEC technical committee 46: Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories.

The text of this standard is based on the following documents:

FDIS	Report on voting
46A/1166/FDIS	46A/1178/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This standard is intended to be read in conjunction with IEC 61196-1. It is based on the second edition (2005) of that standard.

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
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COAXIAL COMMUNICATION CABLES –

Part 9: Sectional specification for RF flexible cables

1 Scope

This part of IEC 61196 applies to RF flexible coaxial communication cables with a characteristic impedance of 50 Ω and with solid or with semi-air-spaced dielectric.

It is to be read in conjunction with IEC 61196-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60096-0-1, *Radio frequency cables – Part 0-1: Guide to the design of detail specifications – Coaxial cables*

IEC 60332 (all parts), *Tests on electric and optical fibre cables under fire conditions*

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

IEC 60811-406, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 406: Miscellaneous tests – Resistance to stress cracking of polyethylene and polypropylene compounds*

IEC 60811-607, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 607: Physical tests – Test for the assessment of carbon black dispersion in polyethylene and polypropylene*

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

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

IEC 61196-1-1, *Coaxial communication cables – Part 1-1: Capability approval for coaxial cables*

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 61196-1-111, *Coaxial communication cables – Part 1-111: Electrical test methods – Test for stability of phase constant*

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

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

IEC 61196-1-203, *Coaxial communication cables – Environmental test methods – Test for water penetration of cable*

IEC 61196-1-206, *Coaxial communication cables – Part 1-206: Environmental test methods – Climatic sequence*

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

IEC 61196-1-314, *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 61196-1-317, *Coaxial communication cables – Part 1-317: Mechanical test methods – Test for crush resistance of cable*

IEC 61196-1-324, *Coaxial communication cables – Part 1-324: Mechanical test methods – Test for abrasion resistance of cable*

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

IEC 62153-1-1, *Metallic communication cables test methods – Part 1-1: Electrical – Measurement of the pulse/step return loss in the frequency domain using the Inverse Discrete Fourier Transformation (IDFT)*

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) – Shielded screening attenuation, test method for measuring of the screening attenuation as up to and above 3 GHz*

IEC/TR 62222, *Fire performance of communication cables installed in buildings*

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 as well as the following apply.

3.1

flexible coaxial communication cable

coaxial cable which can repeat flexure in service

Note 1 to entry: The typical construction for this type of cable is a single inner conductor which can be solid or stranded covered by dielectric core material, which is surrounded by a braided outer conductor(s), with a protective sheath.

4 Materials and cable construction

4.1 Cable construction

The cable construction shall be in accordance with 4.2 to 4.5 and the requirements shall be specified in the detail specification.

4.2 Inner conductor

Subclauses 4.4.1 to 4.4.4 of IEC 61196-1:2005 apply.

The nominal diameter shall be specified in the detail specification.

Diameter tolerance for the completed inner conductor shall be as specified in the detail specification.

The inner conductor shall be smooth and continuous.

4.3 Dielectric

The construction of the dielectric shall be one of the following:

- solid dielectric (such as: Solid polyolefin, Solid polytetrafluoroethylene (PTFE), Solid fluorinated ethylene propylene (FEP), etc.);
- semi-air-spaced dielectric (such as: Foamed polyolefin, Foamed FEP, Low density PTFE, etc.);
- any other appropriate material and type as specified in the detail specification.

The nominal diameter shall be specified in the detail specification.

The tolerance of the dielectric diameter shall be specified in the detail specification.

4.4 Outer conductor or screen

Subclause 4.6.1 of IEC 61196-1:2005 applies, except 4.6.1 c).

The construction, material, maximum diameter of the outer conductor or screen shall be specified in the detail specification.

Minimum coverage factor of braiding shall be specified in the detail specification.

4.5 Sheath

Subclause 4.7 of IEC 61196-1:2005 applies with the following amendments and additions.

- The minimum sheath thickness shall be specified in the detail specification.
- The nominal diameter and tolerance of the sheath shall be specified in the detail specification.

5 Standard ratings and characteristics

5.1 Operational temperatures

The ratings and characteristics applicable to each cable shall be specified in Table 1 or in the detail specification.

Table 1 – Operational temperatures

	Parameter	Requirements/remarks
Storage	Low temperature	Specified in the detail specification.
	High temperature	
Installation	Low temperature	Specified in the detail specification.
	High temperature	
Operational	Low temperature	Specified in the detail specification.
	High temperature	

5.2 Operating frequency

Operating frequency range shall be specified in the detail specification.

5.3 Current-carrying capacity

The value of the current-carrying capacity shall be given in the detail specification, and shall be calculated in accordance with IEC 60096-0-1.

6 Identification, marking and labelling

6.1 Cable identification

Subclause 6.1 of IEC 61196-1:2005 applies.

6.2 IEC marking

The cable marking shall be applied to the sheath. The marking shall consist of the IEC cable type number as given in 6.2 of IEC 61196-1:2005 and/or the manufacturer's designated markings when specified in the detail specification.

NOTE Local or regional regulations may require additional marking.

6.3 Labelling

Unless otherwise stated by local or regional regulations, labelling shall be provided in accordance with 6.3 of IEC 61196-1:2005 and the detail specification.

7 Tests of finished cables

When tested in accordance with the IEC 61196-1 series, the requirements given below shall apply.

Unless otherwise specified, all measurements shall be carried out under standard atmospheric conditions for testing in accordance with Clause 4 of IEC 60068-1:2013.

Applicable test methods shall be in accordance with the IEC 61196-1-n series and other test methods specified herein.

7.1 Electrical testing of the finished cable

7.1.1 Low-frequency and d.c. electrical measurements

Low-frequency and d.c. electrical measurements are given in Table 2.

Table 2 – Low-frequency and d.c. electrical measurements

No.	IEC test procedure	Parameter	Requirements/Remarks
7.1.1.1	61196-1-110 under consideration	Continuity	Inner conductor and outer conductor shall be continuous.
7.1.1.2	61196-1-101	Conductor resistance – inner	If applicable, value in accordance with the relevant detail specification.
7.1.1.3	61196-1-101	Conductor resistance – outer	If applicable, value in accordance with the relevant detail specification.
7.1.1.4	61196-1-102	Insulation resistance	$\geq 1\,000\text{ M}\Omega\cdot\text{km}$, unless otherwise specified in the detail specification.
7.1.1.5	61196-1-105	Withstand voltage of dielectric	The test voltage and duration – specified in the detail specification.

No.	IEC test procedure	Parameter	Requirements/Remarks
7.1.1.6	61196-1-106	Withstand voltage of sheath ^a	Unless otherwise specified in the detail specification, the following test voltage shall be applied for one minute: 2 kV (r.m.s.) for sheath thickness over 0,5 mm and up to and including 0,8 mm. 3 kV (r.m.s.) for sheath thickness over 0,8 mm and up to and including 1,0 mm. 5 kV (r.m.s.) for sheath thickness over 1,0 mm: 5 kV (r.m.s.)
7.1.1.7	62230	Spark test (in-process inspection) ^a	The test voltage and duration – specified in the detail specification.
7.1.1.8	61196-1-103	Capacitance	Specified in detail specification.
7.1.1.9	61196-1-114 under consideration	Inductance	If applicable, value in accordance with the relevant detail specification.
^a Select one of them.			

7.1.2 High-frequency electrical and transmission measurements

High-frequency electrical and transmission measurements are given in Table 3.

Table 3 – High-frequency electrical and transmission measurements

No.	IEC test procedure	Parameter	Requirements/Remarks
7.1.2.1	61196-1-108	Mean characteristic impedance	50 Ω Tolerance specified in detail specification.
7.1.2.2	61196-1-108	Relative propagation velocity (velocity ratio)	Specified in detail specification.
7.1.2.3	61196-1-112	Return loss	Specified in the detail specification, normalized to 20 °C.
7.1.2.4	61196-1-113	Attenuation	The cable shall comply at any frequency with the formula $a \cdot \sqrt{f} + b \cdot f + c + \frac{d}{\sqrt{f}}$. NOTE The term $d / \sqrt{f}$ should be added in case of copper clad conductor material to match the curve at low frequencies. The coefficients a , b , c and d shall be given in the detail specification, as well as the discrete values at 200 MHz and 800 MHz, unless otherwise provided in the detail or sectional specification.
7.1.2.5	61196-1-115	Regularity of impedance	If applicable, perform on both ends of tested cable. Regularity ≥ 40 dB respectively ≤ 1 %. Test procedure: IEC 61196-1-115 (time domain) or IEC 62153-1-1 (transformation from frequency domain into time domain by IDFT).
7.1.2.6	62037-4	PIM	If applicable, PIM shall be measured at min. bend radius, post multi-bends, and clamp tool method, bulk reel. Specified in the detail specification.
7.1.2.7	61196-1-119	RF power rating ^a	If applicable, value in accordance with the relevant detail specification.

No.	IEC test procedure	Parameter	Requirements/Remarks
7.1.2.8	61196-1-111	Phase variation with temperature	If applicable, value in accordance with the relevant detail specification.
7.1.2.9	61196-1-111	Phase stability with mechanic	If applicable, value in accordance with the relevant detail specification.
7.1.2.10	62153-4-3	Transfer impedance	If applicable, value in accordance with the relevant detail specification. If not otherwise specified in the detail specification, the transfer impedance shall be tested after completion of the cable bending test (IEC 61196-1-314) to the detail specification.
7.1.2.11	62153-4-4	Screening attenuation	If applicable, value in accordance with the relevant detail specification. If not otherwise specified in the detail specification, the screening attenuation shall be tested after completion of the cable bending test (IEC 61196-1-314) to the detail specification. An alternative test method can be used when specified in the detail specification.
^a Peak power may be specified according to manufacturer's or customer's specification. An IEC standard is under consideration.			

7.2 Environmental testing of the finished cable

Environmental testing of the finished cable is given in Table 4.

Table 4 – Environmental testing of the finished cable

No.	IEC test procedure	Parameter	Requirements/Remarks
7.2.1	61196-1-201	Cold bend performance	Test method A or B as specified in the detail specification. The test temperature shall be specified in the detail specification. The mandrel diameter is ten (10) times the nominal outside diameter of the cable sample under test. No physical damages of conductors, dielectric and sheaths. No change in return loss after cable returns to room ambient.
7.2.2	61196-1-203	Water penetration	If applicable, specified in the detail specification.
7.2.3	61196-1-206	Climatic sequence	TA, TB and t1 as specified in the detail specification. Number of cycles: 3 minimum. Influenced mechanical and electrical characteristics shall be as specified in the detail specification.
7.2.4	60811-406	Environmental stress	No evidence of cracking on the sheath.
7.2.5	61196-1-204 ^a	Thermal ageing	Specified in the detail specification, transmission characteristics shall remain within the specified limits.
7.2.6	61196-1-209 ^a	Thermal cycling	Transmission characteristics shall remain within the specified limits.
7.2.6	61196-1-209 ^a	UV stability	If applicable, pass
^a under consideration.			

7.3 Mechanical testing of the finished cables

Mechanical testing of the finished cables is given in Table 5.

Table 5 – Mechanical testing

No.	IEC test procedure	Parameter	Requirements/Remarks
7.3.1	Subclause 4.2 of 61196-1:2005	Visual examination	No observable defects.
7.3.2	Subclause 4.3 of 61196-1:2005	Dimensional examination	Specified in the detail specification.
7.3.3	61196-1-301	Ovality of the dielectric	Specified in the detail specification.
7.3.4	61196-1-301	Ovality of the sheath	Specified in the detail specification.
7.3.5	61196-1-302	Eccentricity of dielectric	Specified in the detail specification.
7.3.6	61196-1-302	Eccentricity of the sheath	Specified in the detail specification.
7.3.7	60811-607	Carbon black content	If applicable, specified in the detail specification.
7.3.8	61196-1-313	Adhesion testing	If applicable, specified in the detail specification.
7.3.9	61196-1-314	Bending	Specified in the detail specification. Transmission characteristics shall remain within the specified limits.
7.3.10	61196-1-316	Tensile strength of cable (longitudinal pull)	If applicable, according to the relevant detail specification. Mean characteristic impedance shall remain within the specified limits.
7.3.11	61196-1-317	Crush resistance of cable	The load as specified in the detail specification shall be applied for 2 min. After a 2 min recovery time, the maximum impedance irregularity shall be $\leq 1\%$, when measured in accordance with IEC 61196-1-115. No physical damage of the sheath or jacket.
7.3.12	61196-1-324	Abrasion resistance	If applicable, according to the relevant detail specification.
7.3.13	60068-2-20	Solderability	If applicable, shall be in accordance with 4.4.5 of IEC 61196-1:2005.

7.4 Fire performance test methods

When intended to be installed in constructions, these cables may fall under the requirements of local, regional or governmental regulations for fire and safety standards.

Table 6 outlines some fire tests for which the use is detailed in IEC/TR 62222.