

INTERNATIONAL STANDARD

**Coaxial communication cables –
Part 11: Sectional specification for semi-rigid cables with polyethylene (PE)
dielectric**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COAXIAL COMMUNICATION CABLES –**Part 11: Sectional specification for semi-rigid cables
with polyethylene (PE) dielectric**

FOREWORD

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IEC 61196-6 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 2016. This edition constitutes a technical revision.

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

- a) Clause 1: The scope is more detailed.
- b) Subclause 4.2: Outer diameter ratings of the inner conductor recommended.
- c) Subclause 4.3: Dielectric: outer diameter ratings of the dielectric recommended.
- d) Clause 5: IEC type designation introduced.
- e) Clause 7: Standard ratings and characteristics: completely revised.

f) Clause 8: Requirements of finished cables: completely revised.

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

Draft	Report on voting
46A/1554/FDIS	46A/1559/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/standardsdev/publications.

A list of all the parts in the IEC 61196 series, published under the general title *Coaxial 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

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- withdrawn,
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- amended.

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COAXIAL COMMUNICATION CABLES –

Part 11: Sectional specification for semi-rigid cables with polyethylene (PE) dielectric

1 Scope

This part of IEC 61196 specifies the general requirements of semi-rigid coaxial communication cables with polyethylene (PE) dielectric, including material and construction, IEC type designation, identification, marking and labelling, standard ratings 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 polyethylene (PE) dielectric and tubular outer conductor. These cables are widely used in the interconnection between wireless communication equipment and antenna, as well as RF and microwave electronic equipment, broadcast television, microwave relay, navigation, etc.

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, *Tests 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 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 60811-502, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 502: Mechanical tests – Shrinkage test for insulations*

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 (all parts), *Coaxial communication cables – Part 1: Electrical test methods*

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 61196-1-110, *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 61196-1-201:2009, *Coaxial communication cables – Part 1-201: Environmental test methods – Test for cold bend performance of cable*

IEC 61196-1-203, *Coaxial communication cables – Part 1-203: 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 61196-1-215, *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 61196-1-313, *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 for 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 62037-4, *Passive RF 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) – Test method for measuring of the screening attenuation as up to and above 3 GHz, triaxial method*

IEC 62230, *Electric cables – Spark-test method*

EN 50289-4-17, *Communication cables – Specifications for test methods – Part 4-17: Test methods for UV resistance evaluation of the sheath of electrical and optical fibre cable*

3 Terms and definitions

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

ISO and IEC maintain terminological 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 Materials and cable construction

4.1 Cable construction

Semi-rigid coaxial communication cables with polyethylene (PE) dielectric are composed of inner conductor, insulation, outer conductor and sheath.

4.2 Inner conductor

IEC 61196-1:2005, Subclause 4.4.1 applies.

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

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

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

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

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

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

The recommended outer diameter ratings of the inner conductor are as follows:

1,9 mm (1/4"), 3,55 mm (1/2"), 4,8 mm (1/2"), 9,00 mm (7/8"), 13,1 mm (1-1/4") or as specified in the detail specification.

4.3 Dielectric

The material of the dielectric shall be polyethylene (PE).

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

- solid dielectric,
- air spaced dielectric,
- semi air spaced dielectric (e.g. cellular polyethylene dielectric).

The recommended outer diameter ratings of the dielectric (the rounded value of the approximate outer diameter of the dielectric) are as follows:

5 mm (1/4"), 9 mm (1/2"), 12 mm (1/2"), 22 mm (7/8"), 32 mm (1-1/4") or as specified in the detail specification.

The diameter and tolerance shall be specified in the detail specification.

For cables with corrugated outer conductor, the nominal diameter of the dielectric shall be specified in the detail specification.

For cables with smooth tube outer conductor, the diameter and tolerance of the dielectric shall be stated in the detail specification.

4.4 Outer conductor

The material of the outer conductor shall be copper tube or aluminium tube or as stated in the detail specification.

The conductor shall consist of a corrugated or smooth tube.

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

The diameter and thickness of the outer conductor shall be specified in the detail specification.

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

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

4.5 Sheath

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

- a) The material of the 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 applications or exposed to sunlight, the cable shall pass the UV stability test according to EN 50289-4-17; an IEC test procedure is under consideration.

d) For some special applications, a sheath is not needed.

5 IEC type designation

5.1 Type name

The type name of the cable includes the nominal characteristic impedance and dielectric outer diameter rating, expressed as follows:

- a) The nominal characteristic impedance in ohms, such as 50.
- b) The outer diameter ratings of the dielectric in mm, when needed, the outer diameter ratings of the dielectric in inches may be given in brackets; see Subclause 4.3.

For example: 50-5(1/4") is a cable, its nominal characteristic impedance is 50 Ω and its outer diameter rating of dielectric is 5 mm (1/4 in).

5.2 Variant

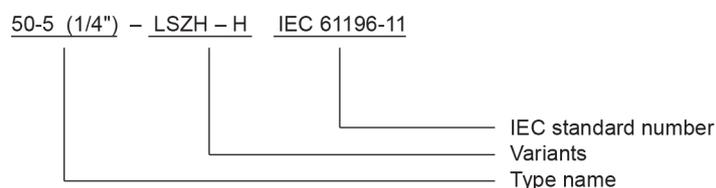
The variant of the cable includes sheath material, outer conductor material and its structure, expressed as follows:

- a) Sheath material
 - PE–Polyethylene
 - LSZH–Low smoke zero halogen polyolefin
- b) Outer conductor material and its structure
 - CT–Smooth copper tube
 - ALT–Smooth aluminium tube
 - H–Helically corrugated copper tube
 - A–Annular corrugated copper tube
 - HL–Helically corrugated aluminium tube
 - AL–Annular corrugated aluminium tube

For example: 50-5(1/4")-PE-CT, PE-CT is one variant of type 50-5(1/4") cable, its sheath material is PE and its outer conductor is smooth copper tube.

5.3 Cable marking

The cable marking consists of cable type, variants and IEC standard number, expressed as follows:



IEC

For example: 50-5(1/4")-LSZH-H IEC 61196-11 indicates a cable, its characteristic impedance is 50 Ω , its approximate diameter of dielectric is 5 mm (1/4"), its sheath is LSZH, and its outer conductor structure and material is helically corrugated copper tube, it complies with IEC 61196-11.

6 Identification, marking and labelling

6.1 Cable identification

IEC 61196-1:2005, Subclause 6.1 applies.

6.2 Cable marking

The cable marking shall be applied to the sheath. The marking shall consist of the IEC cable type designation given in Clause 5 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 specified in the detail specification.

7.2 Rated temperature range

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

Table 1 – Rated temperature

Parameter	PE sheath	LSZH sheath
	°C	°C
Operational temperature range	-40 to 70	-25 to 70
Storage temperature range	-40 to 70	-25 to 70
Installation temperature range	-30 to 60	-15 to 60

7.3 Operating frequency

The maximum operating frequency range is specified in Table 2 or in the detail specification.

Table 2 – Maximum operating frequency

Type	Maximum recommended frequency	Cut-off frequency
	GHz	GHz
50-5	12,00	22,92
50-9	6,00	12,14
50-12	6,00	9,65
50-22	4,80	5,27
50-32	3,60	3,64

NOTE The cut-off frequency is calculated under the condition that the effective dielectric constant of the dielectric is 1,28. The change of the product structure dimension in the manufacturing process will also affect the change of the cut-off frequency.

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 as 10 times the outer diameter of the sheath or as specified in the detail specification.

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 Clause 8 of this part of IEC 61196.

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 the IEC 61196-1 series and other test methods specified herein.

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)	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	$\geq 10^4$ M Ω · km
8.2.6	IEC 61196-1-103	Capacitance	≥ 74 pF/m or value in accordance with the detail specification.
8.2.7	IEC 61196-1-108	Mean characteristic impedance	(50 ± 2) Ω
8.2.8	IEC 61196-1-115	Regularity of impedance	Perform on both ends of tested cable. Regularity ≥ 40 dB or resp ≤ 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	≥ 80 % or value in accordance with the detail specification.
8.2.10	IEC 61196-1-112	Return loss	Specimen length: 20 m, the return loss should meet the following requirements in the actual working frequency band of the cable or according to the relevant detail specifications. $\geq 24,5$ dB (10 MHz to 2 200 MHz) $\geq 21,5$ dB (2 200 MHz to 4 000 MHz) $\geq 20,0$ dB (4 000 MHz to 6 000 MHz) $\geq 19,0$ dB (6 000 MHz to 12 000 MHz)
8.2.11	IEC 61196-1-113	Attenuation constant	Value in accordance with the detail specification.
8.2.12	IEC 61196-1-215	High temperature cable ageing (Attenuation stability)	See 8.3.1
8.2.13	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 -158 dB Input power: 2×20 W Test frequency: 700 MHz, 800 MHz, 900 MHz, 1 800 MHz, 2 100 MHz, 2 600 MHz

Subclause	Test procedure	Parameter	Requirements/Remarks
8.2.14	IEC 62153-4-3	Transfer impedance	When required, value in accordance with the relevant detail specification. The transfer impedance should be tested after the bending test is completed. The bending test is based on the repeated bending required in IEC 61196-1-314:2015, Clause 5. The bending radius is specified in the relevant detail specifications according to different cable types.
8.2.15	IEC 62153-4-4	Screening attenuation	Better than –110 dB (0,5 GHz to 3 GHz) or value in accordance with the relevant detail specification. The screening attenuation should be tested after the bending test is completed. The bending test is based on the repeated bending required in IEC 61196-1-314:2015, Clause 5. The bending radius is specified in the relevant detail specifications according to different cable types.

8.3 Environmental requirements

Environment 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 applicable, the temperature value is: 90 °C ± 2 °C Duration: 168 h or as specified in detail specification. Requirements after ageing and cooling down to standard atmospheric conditions: a) The return loss shall remain within the specified limits in 8.2.10. b) The attenuation shall remain within the specified limits in 8.2.11. c) No crack in inner conductor (when needed) and sheath. d) No visible black spots in the outer conductor.
8.3.2	Method C of IEC 61196-1-201: 2009	Cold bend performance	The test temperature: PE sheath: –30 °C ± 2 °C, LSZH sheath: –15 °C ± 2 °C. No cracks, flaws or other damage in the corrugated outer conductor, inner conductor insulation and sheath or as specified in detail specification. After returning to room temperature, return loss should be kept within the specified range; see 8.2.10.
8.3.3	IEC 61196-1-203	Water penetration	When required, in accordance with the detail specification.
8.3.4	IEC 61196-1-206	Climatic sequence	When required, CUT shall be specified in the detail specification. T_A = minimum environmental rated temperature T_B = maximum environmental rated temperature t_1 = 16 h, unless otherwise specified in the detail specification. Humidity: 55 °C, 93 % RH 1 day (after cold and heat) No. of cycles: 2, unless otherwise specified in the detail specification. No physical damages shall be visible in the cable. The return loss shall remain within the specified limits in 8.2.10.

Subclause	Test procedure	Parameter	Requirements/remarks
8.3.5	IEC 60811-406	Environmental stress cracking	No physical damages shall be visible in cable.
8.3.6	EN 50289-4-17	Ultraviolet stability of the sheath	When applicable (see 4.5), test procedure shall be specified in the 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

Subclause	Test procedure	Parameter	Requirements/remarks
8.4.1	IEC 61196-1:2005, 4.2	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	IEC 61196-1:2005, 4.3	Dimensional examination	Value in accordance with the detail specification.
8.4.3	IEC 61196-1-301	Ovality of inner conductor	≤ 7 %
8.4.4	IEC 61196-1-302	Eccentricity of dielectric	≤ 7 %
8.4.5	IEC 61196-1-313	Adhesion of dielectric	Adhesion ≥ 98 N, value in accordance with the detail specification. a) Test temperature: 20 °C ± 5 °C b) Specimen length: $L = 50$ mm
8.4.6	IEC 61196-1-314:2015	Cable bending	One of the following methods and requirements shall be specified in the detail specification. a) Single bending (IEC 61196-1-314:2015, Clause 4, Procedure 2): single bend radius; b) Repeated bending (IEC 61196-1-314:2015, Clause 5): multiple bend radius and number of bends. Requirements: • The maximum impedance irregularity shall be ≤ 1 %, when measured in accordance with IEC 61196-1-115. • The return loss shall remain within the specified limits in 8.2.10. • No physical damage in the cable. When applicable, PIM shall remain within the specified limits in 8.2.13.
8.4.7	IEC 61196-1-316	Tensile strength of cable (longitudinal pull)	The maximum tension applied shall be greater than or equal to the cable weight of 100 m or be specified in the detail specification. Requirements: • The maximum impedance irregularity shall be ≤ 1 %, when measured in accordance with IEC 61196-1-115. • The return loss shall remain within the specified limits in 8.2.10. • No physical damage in cable.