

INTERNATIONAL STANDARD

**Coaxial communication cables –
Part 8: Sectional specification for semi-flexible cables with fluoropolymer
dielectric**

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INTERNATIONAL STANDARD

**Coaxial communication cables –
Part 8: Sectional specification for semi-flexible cables with fluoropolymer
dielectric**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COAXIAL COMMUNICATION CABLES –

**Part 8: Sectional specification for semi-flexible cables
with fluoropolymer dielectric**

FOREWORD

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IEC 61196-8 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 2012. This edition constitutes a technical revision.

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

- a) Title changed to "Coaxial communication cables – Part 8: Sectional specification for semi-flexible cables with fluoropolymer dielectric";

- b) Subclause 4.3: Other fluoropolymer (such as PFA, etc.) dielectric materials added;
- c) Subclause 4.4: The construction of the outer conductor can consist of two layers or three layers;
- d) Subclause 5.2: Table 1 – "Rated temperature" added;
- e) Subclauses 5.3 5.4 and 5.5: new requirements added;
- f) Clause 7 completely revised;
- g) Annexes A, B and C added.

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

Draft	Report on voting
46A/1618/CDV	46A/1632/RVC

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

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

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

This document is to be read 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.

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 8: Sectional specification for semi-flexible cables with fluoropolymer dielectric

1 Scope

This part of IEC 61196 specifies the materials and cable construction for semi-flexible 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 document applies to semi-flexible coaxial communication cables with fluoropolymer dielectric and tin soaked copper wire braid outer conductor. These cables are intended for use in mobile communication base station antenna systems, terrestrial microwave communication, radar systems and wireless equipment or other signal transmission equipment or units. It is read in conjunction with IEC 61196-1:2005.

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 60068-2-20:2021, *Environmental testing – Part 2-20: Tests – Tests Ta and Tb: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

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 60332-3-24, *Tests on electric and optical fibre cables under fire conditions – Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category C*

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 60966-1:2019, *Radio frequency and coaxial cable assemblies – Part 1: Generic specification – General requirements and test methods*

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 61196-1-1, *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 61196-1-108, *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 61196-1-111, *Coaxial communication cables – Part 1-111: Electrical test methods – Stability of phase test methods*

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 61196-1-116, *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 61196-1-201:2009, *Coaxial communication cables – Part 1-201: Environmental test methods – Test for cold bend performance of cable*

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 61196-1-314:2015, *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 for maximum pulling force of cable*

IEC 61196-10:2022, *Coaxial communication cables – Part 10: Sectional specification for semi-rigid cables with fluoropolymer dielectric*

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

pinhole

any hole in the outer shield (tin soaked copper wire braid) with a diameter not less than 0,05 mm

3.2

semi-flexible coaxial communication cable

coaxial line not intended for applications requiring repeated flexure in service

Note 1 to entry: Bending or forming is however permissible to facilitate installation. The typical construction for this type of cable is a solid wire as inner conductor, polytetrafluoroethylene (PTFE) dielectric and a tin soaked copper wire braid for the outer shield.

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 stated in the relevant detailed specification.

4.2 Inner conductor

The inner conductor shall be a solid silver plated copper wire or solid silver plated copper clad steel wire according to IEC 61196-1:2005, 4.4.1 or any other appropriate material as stated in the relevant detailed specification. The minimum thickness of the silver coating shall be 1 µm.

The nominal diameter shall be stated in the relevant detailed specification.

The tolerance of the diameter shall be stated in the relevant detailed specification.

The inner conductor shall be smooth and continuous.

4.3 Dielectric

The construction of the dielectric shall be one of the materials listed below or a combination of the following:

- solid polytetrafluoroethylene (PTFE) or perfluoroalkoxy (PFA) dielectric,
- expanded polytetrafluoroethylene (PTFE) dielectric,
- profiled (extruded) polytetrafluoroethylene (PTFE) dielectric,
- foamed perfluoroalkoxy (PFA) dielectric,
- or any other fluoropolymer dielectric materials as stated in the relevant detailed specification.

The nominal diameter and thickness shall be stated in the relevant detailed specification.

The tolerance shall be stated in the relevant detailed specification.

4.4 Outer conductor

The construction of the outer conductor should be a smooth and continuous tin soaked copper wire braid. It consists of two layers or three layers:

a) Metal foil layer (when applicable)

Metal foil layer is optional, which can be copper foil or any other metal foils as stated in the relevant detailed specification. Unless otherwise specified in the relevant specification, metal foil is applied longitudinally, with a sufficient overlap as specified in the relevant detailed specification.

b) Braid

The copper wire braid shall be designed in a way to guarantee the mechanical, environmental and electrical requirements of the cable. This is in general achieved by a braid having a coverage of $\geq 95\%$.

c) Tin soaking

The copper wire braid is tin soaked in a way to guarantee the mechanical, environmental and electrical requirements of the cable. It shall also allow a correct tin soaking without an excessive number of pinholes. The surface of the tin soaking shall be without black spots, cracking and an excessive number of pinholes.

The nominal diameter of the outer conductor and the tolerance and the diameter shall be specified in the relevant detailed specification.

4.5 Sheath

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.

- The outer sheath of a cable shall be a thermoplastic material as specified in the relevant detailed specification, including the material type.
- The nominal diameter and minimum thickness and tolerance of sheath shall be as stated in the relevant detailed specification.

5 Standard rating and characteristics

5.1 Nominal characteristic impedance

The nominal characteristic impedance shall be 50 Ω or specified in the relevant detailed specification.

5.2 Rated temperature range

The ratings temperature range shall be as specified in Table 1 or specified in the relevant detailed specification.

Table 1 – Rated temperature

Parameter	FEP sheath or no sheath °C	LSZH sheath °C	PVC sheath °C
Operating temperature range	–55 to 150	–25 to 70	–40 to 75
Storage temperature range	–55 to 150	–25 to 70	–40 to 75
Installation temperature range	–20 to 60	–20 to 60	–20 to 60

5.3 Operating frequency

The operating frequency range shall be specified in the relevant detailed specification.

5.4 Power rating

Power rating shall be specified in the relevant detailed specification.

5.5 Bending radius

The minimum bending radius shall be specified in the relevant detailed specification.

6 Identification, marking and labelling

6.1 Cable identification

6.1.1 Type name

Cables shall be identified by the following:

- a number giving the nominal characteristic impedance of the cable in ohms, for example, "50";
- a number that corresponds to the nominal diameter measured over the outer conductor in inch, i.e. the nominal diameter measured over the outer conductor, in mm, multiplied by 39,38, for example, "141" which means the nominal diameter of the outer conductor is 3,58 mm.

6.1.2 Variants

The variant of cables should be identified by the following:

- type name: see 6.1.1;
- distinguishing number: It should consist of three digital characters (XYZ) which distinguish the different construction and material of different cables.

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

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

The "Z" specifies the material type of the sheath.

The details are listed in Table 2.

Table 2 – Distinguishing number

"X"	Material of inner conductor	"Y"	Material and structure of dielectric	"Z"	Material of sheath
1	Silver plated copper wire	No Entry	Solid PTFE	No Entry	No sheath
2	Silver plated copper clad steel wire	E	Expand PTFE	1	Fluorinated Ethylene Propylene (FEP)
3	Other material	P	Profiled PTFE	2	Polyvinylchloride (PVC)
		FP	Foamed PFA	3	Low Smoke, Zero-Halogen Polyolefin (LSZH)
		SP	Solid PFA	4	Other sheath material
		O	Other material		

6.2 Cable marking

The cable marking shall be applied to the outer conductor (when there is no sheath) or sheath.

The marking shall comply with 6.2 or as specified in the relevant detail specification.

Cable marking shall be made up of the following elements:

- a) variants naming (see 6.1);
- b) the number of the IEC sectional specification.

For example: 50-141-13 IEC 61196-8 means 50 Ω semi-flexible cable with silver plated copper conductor, solid PTFE dielectric, LSZH sheath, 3,58 mm outer conductor nominal diameter according to IEC 61196-8.

6.3 Labelling

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

7 Requirements for finished cables

7.1 General

The cable shall be tested in accordance with the IEC 61196-1 series or this Clause 7. The requirements given below shall apply. Unless otherwise specified, all measurements shall be carried out under standard atmospheric conditions for testing in accordance with IEC 60068-1:2013, Clause 4.

7.2 Electrical measurements of the finished cable

Electrical measurements shall be according to Table 3.

Table 3 – Electrical measurements

Subclause	Parameter	Test procedure	Requirements/Remarks
7.2.1	Continuity	IEC 61196-1-110	Inner conductor shall be continuous Outer conductor shall be continuous
7.2.2	Conductor direct current resistance	IEC 61196-1-101	Value in accordance with the relevant detailed specification
7.2.3	Capacitance	IEC 61196-1-103	Value in accordance with the relevant detailed specification, typical values are for: 50 Ω and solid PTFE dielectric: 94 pF/m 50 Ω and expanded or profiled PTFE dielectric: 86 pF/m 50 Ω and foamed PFA dielectric: 80 pF/m 75 Ω and solid PTFE dielectric: 63 pF/m
7.2.4	Withstand voltage of dielectric	IEC 61196-1-105	Value in accordance with the relevant detailed specification
7.2.5	Withstand voltage of sheath	IEC 62230 (spark test)	Value in accordance with the relevant detailed specification
7.2.6	Characteristic impedance	IEC 61196-1-116	Value in accordance with the relevant detailed specification
7.2.7	Insulation resistance	IEC 61196-1-102	$\geq 104 \text{ M}\Omega \cdot \text{km}$
7.2.8	Relative propagation velocity (velocity ratio)	IEC 61196-1-108	Value in accordance with the relevant detailed specification, typical values are for: Solid dielectric: 70,8 % Expanded or profiled dielectric: 78 % Foamed dielectric: 83 %
7.2.9	Return loss	IEC 61196-1-112	Value in accordance with the relevant detailed specification
7.2.10	Attenuation	IEC 61196-1-113	Value in accordance with the relevant detailed specification
7.2.11	Intermodulation (IM3)	IEC 62037-4	This test is only applicable to 50 Ω cables. When required, both ends of the cable sample should be attached with type 7-16 connectors (according to IEC 61169-4). Input signal frequencies and the minimum IM requirement shall be specified in the relevant detailed specification.
7.2.12	Screening attenuation	IEC 62153-4-4	Test frequency range: $500 \text{ MHz} \leq f \leq 3 \text{ GHz}$ Requirement: Better than 100 dB
7.2.13	Phase stability vs temperature	IEC 61196-1-111	When applicable, test temperature, test frequency and value in accordance with the relevant detailed specification
7.2.14	Phase stability vs bending	IEC 61196-1-111	When applicable, test frequency, diameter of mandrel and value in accordance with the relevant detailed specification
7.2.15	Phase difference	IEC 60966-1:2019 Subclause 8.7	When applicable, at least two samples are taken and fitted with suitable connectors for testing Samples length, test frequency and phase difference shall be specified in the detailed specification
7.2.16	Corona extinction voltage	IEC 61196-1-126	When required, value in accordance with the relevant detailed specification
7.2.17	RF power	IEC 61196-1-119	When required, value in accordance with the relevant detailed specification

7.3 Environmental testing of the finished cable

Environmental testing shall be according to Table 4.

Table 4 – Environmental testing of the finished cable

Subclause	Parameter	Test procedure	Requirements/remarks
7.3.1	Cold bend performance	IEC 61196-1-201:2009 Method B	The temperature value is: –55 °C ± 2 °C (FEP sheath) –40 °C ± 2 °C (PVC sheath) –25 °C ± 2 °C (LSZH sheath) The mandrel diameter is ten (10) times the nominal outside diameter of the cable sample under test. Requirement: No cracks, flaws or other damage in the cable surface.
7.3.2	Resistance to soldering	Annex A	Value in accordance with the relevant detailed specification
7.3.3	Ageing	IEC 61196-1-215	When required, one sample should be used for the test. The temperature value is: 230 °C ± 5 °C (FEP sheath or no sheath) 100 °C ± 2 °C (PVC sheath) 100 °C ± 2 °C (LSZH sheath) Duration: 168 h or as specified in the relevant detailed specification. Requirements after ageing and cooling down to standard atmospheric conditions. The displacement of the cable elements shall comply with that indicated in the relevant detailed specification. No cracks, flaws or other damage in the cable surface.
7.3.4	Stress-crack resistance (for FEP sheath)	Annex B	The diameter of mandrel shall be specified in the relevant detailed specification. No cracks, flaws or other damage in the cable surface.
7.3.5	Thermal shock	IEC 61196-10:2022, Annex B	When required, one sample should be used for the test. The test temperature is specified in the relevant detailed specification. Duration: see IEC 61196-10:2022, Annex B or as specified in the relevant detailed specification. Cycles: 5 or as specified in the relevant detailed specification. Requirements: The displacement of the cable elements shall comply with that indicated in the relevant detailed specification. No cracks, flaws or other damage in the cable surface.
7.3.6	Damp heat (steady state)	IEC 60068-2-78	When required, test temperature, relative humidity and duration are specified in the relevant detailed specification. No cracks, flaws or other damage in the cable surface.

7.4 Mechanical testing of the finished cable

Mechanical testing shall be according to Table 5.

Table 5 – Tests for mechanical characteristics of the finished cable

Subclause	Parameter	Test procedure	Requirements/remarks
7.4.1	Visual examination	IEC 61196-1:2005, Subclause 4.2	No cracks, splits, irregularities, and imbedded foreign material in the sheath No black spots or cracking in the outer conductor
7.4.2	Dimensional examination	IEC 61196-1:2005, Subclause 4.3	Value in accordance with the relevant detailed specification
7.4.3	Ovality of dielectric	IEC 61196-1-301	Value in accordance with the relevant detailed specification
7.4.4	Eccentricity of dielectric	IEC 61196-1-302	Value in accordance with the relevant detailed specification
7.4.5	Ovality of sheath	IEC 61196-1-301	Value in accordance with the relevant detailed specification
7.4.6	Adhesion testing	IEC 61196-1-313	Value in accordance with the relevant detailed specification
7.4.7	Bending	IEC 61196-1-314:2015, Subclause 4.3.2	Test procedure, bend radius and requirements according to the relevant detailed specification
7.4.8	Repeated bending	IEC 61196-1-314:2015, Clause 5	Number of cycles, mass of the weight, bending radius and requirements according to the relevant detailed specification
7.4.9	Tensile strength of cable (longitudinal pull)	IEC 61196-1-316	Value in accordance with the relevant detailed specification
7.4.10	Pinhole of the finished cable	Annex C	≤ 10 pinholes per meter, and no pinholes with a diameter more than 0,2 mm
7.4.11	Tensile strength and elongation (for cable with sheath)	IEC 60811-501	When required. Before ageing, tensile strength and elongation of the sheath shall be in accordance with the relevant detailed specification. Ageing temperature: 230 °C ± 5 °C (FEP sheath) 100 °C ± 2 °C (PVC sheath) 100 °C ± 2 °C (LSZH sheath) Duration:168 h After ageing, tensile strength and elongation of the sheath shall be in accordance with the relevant detailed specification.

7.5 Fire performance requirements

When required by users, cables with FEP and LZSH sheath shall be according to Table 6. When intended to be installed in the constructions, these cables shall meet the requirements of local, regional or governmental regulations for fire and safety standards.

Table 6 – Fire performance requirements

Subclause	Parameter	Test procedure	Requirements/Remarks
7.5.1	Vertical flame propagation for a single insulated wire or cable	IEC 60332-1-2	This test is applicable to the cables with LSZH sheath. 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 is specified in the relevant detailed specification.
7.5.2	Vertical flame spread of vertically-mounted bunched wires or cables — Category C	IEC 60332-3-24	This test is applicable to the cables with FEP sheath. The maximum extent of the charred portion measured on the sample shall not have reached a height exceeding 2,5 m above the bottom edge of the burner. Fire performance requirements for other jacket materials should be specified in the relevant detailed specification.

7.6 Content of toxic and harmful substance

When required, the content of toxic and harmful substances in the cable shall not exceed the requirements in Table 7.

Table 7 – Content of toxic and harmful substance

Types of toxic and harmful substances	Substances name	Limit content (ppm ^a)
Heavy metal	Lead (Pb)	1 000
	Cadmium (Cd)	100
	Mercury (Hg)	1 000
	Hexavalent Chromium (Cr VI)	1 000
Organic bromide	Polybrominated biphenyls (PBB)	1 000
	Polybrominated Diphenyl Ethers (PBDE)	1 000
Phthalate	Dibutyl phthalate (DBP)	1 000
	Butyl benzyl phthalate (BBP)	1 000
	Bis (2-ethylhexyl) phthalate (DEHP)	1 000
	Diisobutyl phthalate (DIBP)	1 000
NOTE The limit content in the table is the upper limit of the ratio of the quality of a certain toxic and harmful substance in the material to the quality of the material itself.		
^a ppm stands for part per million.		

8 Quality assessment

When specified in the relevant detailed specifications, quality procedures shall be in accordance with IEC 61196-1-1.

9 Delivery and storage

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

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Annex A (normative)

Resistance to soldering

A.1 Preparation of test sample (TS)

Cut a $150 \text{ mm} \pm 10 \text{ mm}$ length of cable as a test sample (TS), and cut its both ends flat, remove the sheath of the TS. Carefully bend the TS at a distance of 30 mm from the two ends so that the two ends form an angle of $135^\circ \pm 5^\circ$. The bending radius shall be according to the relevant detailed specifications.

A.2 Test procedure

Immerse both ends of the TS into a solder bath in accordance with test T6, method 1 (solder bath at 260°C) of IEC 60068-2-20:2021 separately. The flux to be used shall be as indicated in IEC 60068-2-20:2021, plus a 0,5 % mass of hydroxylamine-chlorhydrate.

Immersion depth: $25 \text{ mm} \pm 1 \text{ mm}$

Immersion time: 10 s

After the test, let the test sample cool naturally and then measure the two ends with an accuracy of 0,1 mm:

- a) displacement of the dielectric relative to inner conductor;
- b) displacement of the outer conductor relative to the dielectric.

A.3 Requirements

All the displacement measured shall not be more than the values indicated in the relevant detailed specification.