

INTERNATIONAL STANDARD

**Coaxial communication cables –
Part 10: Sectional specification for semi-rigid cables with
polytetrafluoroethylene (PTFE) dielectric**



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Part 10: Sectional specification for semi-rigid cables with
polytetrafluoroethylene (PTFE) dielectric**

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CONTENTS

FOREWORD.....	3
1 Scope.....	5
2 Normative references	5
3 Terms and definitions	6
4 Materials and cable construction	6
4.1 Cable construction	6
4.2 Inner conductor	6
4.3 Dielectric	7
4.4 Outer conductor	7
4.5 Sheath (when applicable).....	7
5 Standard rating and characteristics.....	7
5.1 Characteristic impedance	7
5.2 Rated temperature range	7
6 Identification, marking and labeling.....	8
6.1 Cable identification	8
6.1.1 Type name	8
6.1.2 Variants	8
6.2 IEC marking	8
6.3 Labelling	8
7 Requirements of finished cables	8
7.1 General.....	8
7.2 Electrical requirements (see Table 1)	8
7.3 Environmental requirements (see Table 2)	10
7.4 Mechanical requirements (see Table 3).....	10
8 Delivery and storage.....	11
Annex A (informative) Quality assessment	12
A.1 General.....	12
A.2 Qualification approval and its maintenance	12
A.2.2 Capability approval	14
A.2.3 Quality conformance inspection	14
A.2.4 Periodic inspection	16
Bibliography.....	17
Table 1 – Electrical requirements.....	9
Table 2 – Environmental requirements	10
Table 3 – Mechanical requirements.....	10
Table A.1 – Qualification inspection	13
Table A.2 – Quality conformance inspection	15

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COAXIAL COMMUNICATION CABLES –

**Part 10: Sectional specification for semi-rigid cables
with polytetrafluoroethylene (PTFE) dielectric**

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International Standard IEC 61196-10 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/1213/FDIS	46A/1232/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 publication 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 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,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

COAXIAL COMMUNICATION CABLES –

Part 10: Sectional specification for semi-rigid cables with polytetrafluoroethylene (PTFE) dielectric

1 Scope

This part of IEC 61196 applies to semi-rigid coaxial communication cables with polytetrafluoroethylene (PTFE) dielectric and tubular outer conductor. These cables are intended for use in microwave and wireless equipments or other signal transmission equipments or units at frequencies above 500 MHz. It is to be read in conjunction with IEC 61196-1:2005.

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 60068-1:1988, *Environmental testing – Part 1: General and guidance*
IEC 60068-1:1988/AMD 1:1992

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 61196-1-112, *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 61196-1-301, *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 61196-1-318, *Coaxial communication cables – Part 1-318: Mechanical test methods – Heat performance tests*

IEC 62037-4:2012, *Passive RF and microwave devices, intermodulation level measurement – Part 4: Measurement of passive intermodulation in coaxial cables*

IEC 62230:2006, *Electric cables – Spark-test method*

ISO 2859-1:1999, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

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

semi-rigid coaxial communication cable

coaxial line, not intended to be bent or flexed in service or not intended to be flexed after initial forming

Note 1 to entry: Any bending or flexing during installation or use may degrade the performance of cable. It is not intended to be bent after installation.

Note 2 to entry: The typical construction for this type of cables is a solid metallic core as inner conductor, polytetrafluoroethylene (PTFE) dielectric and a seamless copper or other metallic tubing outer conductor.

4 Materials and cable construction

4.1 Cable construction

The cable construction shall be in accordance with 4.2 to 4.5 of this standard and the requirements stated in the relevant detail specification.

4.2 Inner conductor

The inner conductor shall be in accordance with 4.4.1 of IEC 61196-1:2005.

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

The tolerance of the diameter shall be $\pm 3\%$.

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) dielectric;
- low-density polytetrafluoroethylene (PTFE) dielectric;

or any other appropriate PTFE type material as stated in the relevant detail specification.

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

The tolerance shall be $\pm 3\%$.

4.4 Outer conductor

The outer conductor shall be a copper or aluminum tube with or without coating.

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

The nominal diameter of outer conductor shall be stated in the relevant detail specification.

The tolerance of the diameter shall be $\pm 1\%$.

The corrugated outer conductor shall be smooth and continuous.

4.5 Sheath (when applicable)

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

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

5 Standard rating and characteristics

5.1 Characteristic impedance

The characteristic impedance is specified in the relevant detail specification.

5.2 Rated temperature range

The rated operational, storage and installation temperature range shall be specified in the relevant detail specification.

6 Identification, marking and labeling

6.1 Cable identification

6.1.1 Type name

Cables shall be identified by the following:

- a) A number giving the nominal characteristic impedance of the cable in ohms,
For example, "50".
- b) 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:

- a) Type name: see 6.1.1.
- b) Distinguishing number: It should consist of three digital characters (XYZ) which distinguish the different construction and material and its coating of different cables. It shall be stated in the relevant detail specification.

6.2 IEC marking

IEC marking shall be made up of the following elements:

- a) variants naming (see Clause 6);
- b) the number of the IEC sectional specification.

6.3 Labelling

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

7 Requirements of finished cables

7.1 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 specification. Unless otherwise specified, all measurements shall be carried out under standard atmospheric conditions for testing in accordance with Clause 5 of IEC 60068-1:1988/AMD 1:1992.

7.2 Electrical requirements (see Table 1)

Table 1 – Electrical requirements

No.	IEC test procedure	Parameter	Requirements/Remarks
7.2.1	61196-1-110 (under consideration)	Continuity	Inner conductor and outer conductor shall be continuous
7.2.2	IEC 61196-1-101	Conductor direct current resistance	Value in accordance with the relevant detail specification
7.2.3	IEC 61196-1-105	Withstand voltage of dielectric	Value in accordance with the relevant detail specification
7.2.4	IEC 62230 (spark test)	Withstand voltage of sheath	When applicable, value in accordance with the relevant detail specification
7.2.5	IEC 61196-1-102	Insulation resistance	$\geq 10^4 \text{ M}\Omega \cdot \text{km}$
7.2.6	IEC 61196-1-103	Capacitance	Value in accordance with the relevant detail specification, typical values are for: 50 Ω and solid PTFE dielectric: 96 pF/m 50 Ω and low density PTFE dielectric: 88 pF/m 75 Ω and solid PTFE dielectric: 63 pF/m 75 Ω and low density PTFE dielectric: 58 pF/m
7.2.7	IEC 61196-1-108	Mean characteristic impedance	Value in accordance with the relevant detail specification, typical values are 25 Ω , 35 Ω , 50 Ω , 75 Ω , 93 Ω , 100 Ω
7.2.8	IEC 61196-1-115	Regularity of impedance	Value in accordance with the relevant detail specification
7.2.9	IEC 61196-1-108	Relative propagation velocity (velocity ratio)	Value in accordance with the relevant detail specification, typical values are for: Solid PTFE dielectric: 69,5 % Low density PTFE dielectric: 76 %
7.2.10	IEC 61196-1-112	Return loss	Value in accordance with the relevant detail specification
7.2.11	IEC 61196-1-113	Attenuation	The cable shall comply at any frequency with the formula: $a \times \sqrt{f} + b \times f + c$ The coefficients a and b shall be given in the relevant detail specification covering the range of frequency.
7.2.12		Attenuation stability	a) Preconditioning temperature: 20 °C, Duration: 16 h b) Initial measurements: The attenuation shall be measured in accordance with IEC 61196-1-113. c) Test: The specimen shall be submitted three times to the following cycle: – 4 h at high temperature (according to the detail specification); – between 4 h and 24 h at room temperature; – 4 h at low temperature (according to the detail specification); – between 4 h and 24 h at room temperature. d) Final measurements The attenuation shall be measured in accordance with IEC 61196-1-113.
7.2.13	IEC 62037-4:2012	Intermodulation (IM3)	This test is only applicable to 50 Ω type cables when required. Value and procedure in accordance with the relevant detail specification. Both ends of the specimen should be attached with type 7-16 connectors (according to IEC 61169-4). Input signal frequencies and power of f_1 and f_2 and the minimum IM requirement shall be specified in the relevant detail specification.

7.3 Environmental requirements (see Table 2)

Table 2 – Environmental requirements

No.	IEC test procedure	Parameter	Requirements/remarks
7.3.1	IEC 61196-1-215 (under consideration)	Dimensional stability	The displacement of the cable elements shall comply with that indicated in the relevant cable specification.
7.3.2	IEC 61196-1-318	Heat behaviour	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.
7.3.3	IEC 61196-1-209 (under consideration)	Ageing	When applicable, the temperature value is in accordance with the relevant detail specification. Requirements after ageing and cooling down to standard atmospheric conditions for testing in accordance with Clause 5 of IEC 60068-1:1988/AMD 1:1992. The transmission characteristics according to Table 1 shall remain within the specified limits. No black spots or cracking in the outer conductor
7.3.4	IEC 61196-1-305 Procedure A (under consideration)	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.
7.3.5	IEC 61196-1-305 Procedure B (under consideration)	Resistance to soldering	Value in accordance with the relevant detail specification

7.4 Mechanical requirements (see Table 3)

Table 3 – Mechanical requirements

No.	IEC test procedure	Parameter	Requirements/remarks
7.4.1	IEC 61196-1:2005 Subclause 4.2	Visual examination	No black spots or cracking in the outer conductor
7.4.2	IEC 61196-1:2005 Subclause 4.3	Dimensional examination	Value in accordance with the relevant detail specification
7.4.3	IEC 61196-1-301	Ovality of dielectric	Value in accordance with the relevant detail specification
7.4.4	IEC 61196-1-302	Eccentricity of dielectric	8 %, or value in accordance with the relevant detail specification
7.4.5	IEC 61196-1-301	Ovality of sheath	When applicable, value in accordance with the relevant detail specification
7.4.6	IEC 61196-1-313	Adhesion testing	When applicable, value in accordance with the relevant detail specification
7.4.7	IEC 61196-1-314:2006	Test for bending characteristics	Test according to 4.3.2 of IEC 61196-1-314:2006, Procedure 1, 1 cycle, unless otherwise specified in the relevant cable specification. There shall be neither cracks nor longitudinal splits in the outer conductor. Transmission characteristics shall remain within specified tolerances
7.4.8	IEC 61196-1-209 (under consideration)	Thermal cycling	Test details and requirements shall be given in the relevant detail specification.

8 Delivery and storage

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

Annex A (informative)

Quality assessment

A.1 General

Quality assessment procedures may be agreed between manufacturer and customer.

Annex A 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.

A.2 Qualification approval and its maintenance

A.2.1.1 Qualification approval

A.2.1.1.1 Sample

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

A.2.1.1.2 Inspection routine

The samples shall be subjected to the inspections specified in Table A.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.

A.2.1.1.3 Failure

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

A.2.1.2 Maintenance of qualification approval

This shall consist of three consecutive lots passing test groups A specified in A.1.3.1.6 and B specified in A.1.3.1.7 and followed by selection of specimens from the lots as appropriate. These specimens shall successfully pass the periodic inspection (test groups C) specified in A.1.4.

Table A.1 – Qualification inspection

Parameter	Requirement subclause	Test methods	Number of specimens to be tested
Group I			
Visual examination	7.4.1	IEC 61196-1:2005, Subclause 4.2	Entire sample
Dimensional examination	7.4.2	IEC 61196-1:2005, Subclause 4.3	Entire sample
Continuity	7.2.1	IEC 61196-1-110 (under consideration)	Entire sample
Conductor direct current resistance	7.2.2	IEC 61196-1-101	Entire sample
Withstand voltage of dielectric	7.2.3	IEC 61196-1-105	Entire sample
Withstand voltage of sheath ^a	7.2.4	IEC 62230 (spark test)	Entire sample
Insulation resistance	7.2.5	IEC 61196-1-102	Entire sample
Group II			
Ovality of dielectric	7.4.3	IEC 61196-1-301	2
Eccentricity of dielectric	7.4.4	IEC 61196-1-302	2
Ovality of sheath ^a	7.4.5	IEC 61196-1-301	2
Capacitance	7.2.6	IEC 61196-1-103	1
Mean characteristic impedance	7.2.7	IEC 61196-1-108	1
Regularity of impedance	7.2.8	IEC 61196-1-115	1
Relative propagation velocity (velocity ratio) ^b	7.2.9	IEC 61196-1-108	1
Return loss	7.2.10	IEC 61196-1-112	2
Attenuation	7.2.11	IEC 61196-1-113	2
Attenuation stability	7.2.12		2
Intermodulation (IM3) ^b	7.2.13	IEC 62037-4:2012	2
Adhesion testing ^c	7.4.6	IEC 61196-1-313	3
Bendability	7.4.7	IEC 61196-1-314	3
Dimensional stability	7.3.1	IEC 61196-1-215 (under consideration)	3
Heat behaviour	7.3.2	IEC 61196-1-318	3
Ageing ^a	7.3.3	IEC 61196-1-209 (under consideration)	3
Solderability	7.3.4	IEC 61196-1-216 (under consideration)	3
Resistance to soldering	7.3.5	IEC 61196-1-217 (under consideration)	3
^a Applicable to cable with sheath. ^b When required. ^c When applicable			

A.2.2 Capability approval

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

A.2.3 Quality conformance inspection

A.2.3.1 Inspection of product for delivery

A.2.3.1.1 General

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

A.2.3.1.2 Unit of product

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

A.2.3.1.3 Inspection lot

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

A.2.3.1.4 Sample unit

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

A.2.3.1.5 Specimen

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

A.2.3.1.6 Test groups A

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

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

A.2.3.1.7 Test groups B

Group B inspection shall consist of the examinations and tests specified in Table A.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 A.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.

Table A.2 – Quality conformance inspection

Parameter	Requirement subclause	Test methods	Sampling plan
Test groups A			100 % inspection required
Visual examination	7.4.1	IEC 61196-1:2005, Subclause 4.2	
Continuity	7.2.1	IEC 61196-1-101	
Withstand voltage of dielectric	7.2.3	IEC 61196-1-105	
Withstand voltage of sheath ^a ,	7.2.4	IEC 62230 (spark test)	
Test groups B			ISO 2859-1 for general inspection level II, AQL=4.0
Dimensional examination	7.4.2	IEC 61196-1:2005, Subclause 4.3	
Insulation resistance	7.2.5	IEC 61196-1-102	
Conductor direct current resistance	7.2.2	IEC 61196-1-101	
Ovality of dielectric	7.4.3	IEC 61196-1-301	
Eccentricity of dielectric	7.4.4	IEC 61196-1-302	
Ovality of sheath ^a ,	7.4.5	IEC 61196-1-301	
Capacitance	7.2.6	IEC 61196-1-103	
Mean characteristic impedance	7.2.7	IEC 61196-1-108	
Regularity of impedance	7.2.8	IEC 61196-1-115	
Relative propagation velocity (velocity ratio)	7.2.9	IEC 61196-1-108	
Return loss	7.2.10	IEC 61196-1-112	
Attenuation	7.2.11	IEC 61196-1-113	
Adhesion testing ^c	7.4.6	IEC 61196-1-313	
Bendability	7.4.7	IEC 61196-1-314	
Test groups C			See A.1.4
Attenuation stability	7.2.12	IEC 61196-1-209	
Intermodulation (IM3) ^b	7.2.13	IEC 62037-4:2012, Clause 8	
Dimensional stability	7.3.1	IEC 61196-1-215 (under consideration)	
Heat behaviour	7.3.2	IEC 61196-1-318	
Ageing ^a	7.3.3	IEC 61196-1-209 (under consideration)	
Solderability	7.3.4	IEC 61196-1-216 (under consideration)	
Resistance to soldering	7.3.5	IEC 61196-1-217 (under consideration)	
^a Applicable to cable with sheath.			
^b When required.			
^c When applicable.			

A.2.4 Periodic inspection

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

No failures shall be permitted for group C inspection.

Bibliography

IEC 61196-1-110, *Coaxial communication cables – Part 1-110: Electrical test methods – Continuity*¹

IEC 61196-1-209, *Coaxial communication cables – Part 1-209: Environmental test methods – Thermal cycling*²

IEC 61196-1-215, *Coaxial communication cables – Part 1-215: Environmental test methods – Dimensional stability*³

IEC 61196-1-216, *Coaxial communication cables – Part 1-216: Environmental test methods – Solderability*⁴

IEC 61196-1-217, *Coaxial communication cables – Part 1-217: Environmental test methods – Resistance to soldering*⁵

IEC 61196-1-305, *Coaxial communication cables – Part 1-305: Mechanical test methods – Solderability*

¹ Under consideration.

² Under consideration.

³ Under consideration.

⁴ Under consideration.

⁵ Under consideration.

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