IEC 61196-4

Edition 4.0 2022-09
COMMENTED VERSION

INTERNATIONAL STANDARD

colour inside

Coaxial communication cables –
Part 4: Sectional specification for radiating cables

IEC 61196-4:2022-09 CMV(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Part 4: Sectional specification for radiating cables

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This commented version (CMV) of the official standard IEC 61196-4:2022 edition 4.0 allows the user to identify the changes made to the previous IEC 61196-4:2015 edition 3.0. Furthermore, comments from IEC SC 46A experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 61196-4 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 fourth edition cancels and replaces the third edition published in 2015. This edition constitutes a technical revision.

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

a) rewrote "1 Scope" to be consistent with other blank detail specifications of coaxial cables;
b) updated different standards in "Clause 2 Normative references";
c) added the definitions of uniformly radiating type cable, stop frequency band and link loss;
d) added different materials and constructions in 4.2 to 4.5;
e) added "Clause 5 IEC type designation";
f) added a detailed rated temperature range of different materials in "6.2 Rated temperature range";
g) added detailed frequencies in "6.3 Operating frequency range";
h) added "6.4 Stop frequency band" and "6.5 Radiating characteristics";
i) added different detail requirements or typical values in 8.2.4, 8.2.7, 8.2.8, 8.4.3 to 8.4.8;
j) deleted "7.4.4 Ovality of outer conductor";
k) added "8.2.11 Link loss", "8.4.9 Adhesion of dielectric", "8.4.10 Shrinkage for insulations", "8.4.11 Maximum pulling force of cable";
l) used IEC 61196-1-123 and IEC 61196-1-124 in the electrical requirements to replace Annex A and Annex B respectively and deleted Annex A and Annex B;
m) added "Figure A.1 Example of testing coupling loss around circumferential orientation of radiating cable (Y-Z)" in Annex A.

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

Draft	Report on voting
46A/1583/FDIS	46A/1598/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/publications.

This part of IEC 61196 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.

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COAXIAL COMMUNICATION CABLES –

Part 4: Sectional specification for radiating cables

1 Scope

~~This part of IEC 61196 applies to radiating coaxial communication cables. These cables are intended for use in wireless communication systems, such as tunnels, railways, highways, subways, elevators and other installations in which conventional antenna transmission is not satisfactory or even impossible.~~

~~It is to be read in conjunction with IEC 61196-1:2005.~~

This part of IEC 61196 applies to radiating coaxial communication cables, and specifies the terms and definitions, material and construction, IEC type designation, standard rating and characteristics, identification, marking and labelling, requirements of finished cables, quality assessment, delivery and storage, etc. Radiating coaxial communication cables are widely used in wireless communication systems for long, narrow, semi-enclosed and indoor environments, such as high-speed railways, subways, tunnels, and indoor environments.

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 60068-2-61, *Environmental testing – Part 2-61: Test methods: Test Z/ABDM: Climatic sequence*

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 TS 60695-7-50[1], *Fire hazard testing – Part 7-50: Toxicity of fire effluent – Estimation of toxic potency – Apparatus and test method*

IEC TS 60695-7-51[2], *Fire hazard testing – Part 7-51: Toxicity of fire effluent – Estimation of toxic potency – Calculation and interpretation of test results*

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*

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1 Withdrawn.

2 Withdrawn.

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~~:2005~~, *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 61196-1-100, *Coaxial communication cables – Part 1-100: Electrical test methods – General requirements*

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

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

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

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

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

IEC 61196-1-108, *Coaxial communication cables – Part 1-108: Electrical test methods – Test for characteristic impedance, phase and group delay, electrical length and propagation velocity*

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

IEC 61196-1-112, *Coaxial communication cables – Part 1-112: Electrical test methods – Test for return loss (uniformity of impedance)*

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

IEC 61196-1-123[3], *Coaxial communication cables – Part 1-123: Electrical test methods – Test for attenuation constant of radiating cable*

IEC 61196-1-124, *Coaxial communication cables – Part 1-124: Electrical test methods – Test for coupling loss of radiating cable*

IEC 61196-1-200, *Coaxial communication cables – Part 1-200: Environmental test methods – General requirements*

[3] Under preparation. Stage at the time of publication: IEC/CDV 61196-1-123:2022.

IEC 61196-1-201, ~~*Environmental test methods*~~ *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 61196-1-300, *Coaxial communication cables – Part 1-300: Mechanical test methods – General requirements*

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:~~2006~~2015, *Coaxial communication cables – Part 1-314: Mechanical test methods – Test for bending*

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

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61196-1:2005 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
radiating ~~(coaxial)~~ cable
coaxial communication cable with outer conductor that is intentionally not completely closed, so that part of the electromagnetic wave energy transmitted or received through the cable is coupled by a bidirectional transmission system formed by the outer conductor of the cable and the external environment

Note 1 to entry: The coupling intensity between the cable and mobile equipment depends on:

– the construction of the cable;

– the characteristics of the antenna (such as the type, the orientation, gain, etc.);

– the distance and orientation of the mobile antenna from the cable;

– the nature of ambient atmosphere;

– the operating frequency range;

– the manner of installation of the cable;

– the shape, material and size of surrounding buildings.

3.2
uniformly radiating type cable 1
radiating cable with its outer conductor intentionally slotted in different slots along the cable, so that electromagnetic energy radiating along the cable is uniform in a specific frequency range

Note 1 to entry: According to the design, the end of the input signal is the transceiver end, and the other is the load end.

3.3
stop frequency band 2
frequency band at which the peak of attenuation or standing wave appears due the cable construction, such as the slot pitch

Note 1 to entry: Stop frequency band cannot be used to transmit signals.

3.4
coupling loss
L_c
ratio of the power P_t transmitted into the radiating cable at one point to the power P_r received by a half-wavelength dipole antenna located at a distance from the radiating cable at the same point (see formula (1))

$$L_c = 10\log_{10}\frac{P_t}{P_r} \quad (1)$$

where

L_c is coupling loss, in dB;

P_t is the transmission power in the radiating cable at one point, in W;

P_r is the receiving power of the half-wavelength dipole antenna at a distance from the radiating cable at the same point, in W.

Note 1 to entry: Coupling loss is an important parameter of radiating coaxial cables to distinguish them from general coaxial communications cables.

3.5
link loss 3
ratio of the input power P_{in} transmitted into the transceiver end of the radiating cable from the signal source to the power P_r received by a half-wavelength dipole antenna located at a distance from the radiating cable, expressed by formula (2):

$$L_L = 10\log_{10}\frac{P_{in}}{P_r} \quad (2)$$

where

L_L is the link loss, in dB;

P_{in} is the input power transmitted into the transceiver end of the radiating cable from the signal source, in W;

P_r is the receiving power of the half-wavelength dipole antenna at a distance from the radiating cable, in W.

4 Materials and ~~cable~~ construction

4.1 General

~~**4.1 Cable construction**~~

The cable is composed of the inner conductor, dielectric, outer conductor and sheath; its construction shall be in accordance with 4.2 to 4.5 of this document and the requirements stated in the detail specification.

4.2 Inner conductor

~~**4.2.1 Conductor material**~~

~~Subclauses 4.4.1 to 4.4.3 of IEC 61196-1:2005 apply.~~

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

~~**4.2.2 Conductor construction**~~

IEC 61196-1:2005, 4.4.1 to 4.4.3 apply.

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

The conductor shall consist of a solid wire, corrugated or smooth tube, ~~etc~~ or as stated in the detail specification.

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

The inner conductor diameter (and thickness for smooth tube inner conductor) shall be stated in the detail specification.

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

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

4.3 Dielectric

The dielectric material shall be as stated in the detail specification.

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

– solid dielectric;
– air spaced dielectric;
– semi air spaced dielectric (e.g. cellular polymer dielectric).

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

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

9 mm (3/8"), 12 mm (1/2"), 22 mm (7/8"), 32 mm (1 1/4"), 42 mm (1 5/8") or as stated in the detail specification.

4.4 Outer conductor

The outer conductor material shall be plain or coated copper wire, metallic tape with or without slots as stated in the detail specification.

The typical ~~structure~~ construction of the outer conductor shall be braid with low~~er~~ coverage, or slotted tape(s) rounding, or slotted corrugated tube, or slotted smooth tube, ~~etc~~ or as stated in the detail specification.

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

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

b) The typical material of sheath shall be PE, LSZH, PVC, etc.

c) The diameter and thickness and tolerance of sheath shall be as stated in the detail specification.

d) For self-supporting cables, the cable design will be an 8-figure design including a messenger wire. The messenger wire position versus the coupling holes will be such that it favours the foreseen radiating pattern.

e) For cables intended for outdoor use or exposed to sunlight, the cable shall pass the UV stability test according to IEC specification. ~~(A respective UV test procedure is under consideration.)~~

~~e) A non-conductive ribbon or tape under the sheath may be permitted.~~

f) Under the sheath, strips that meet product performance requirements can be permitted, such as non-conductive strips, flame-retardant strips, etc.

5 IEC type designation 4

5.1 Type name

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

a) the nominal characteristic impedance, in ohms, such as "50";

a) the outer diameter ratings of the dielectric, in millimetres (inch). See Subclause 4.3.

Example: 50-22 (7/8") is a cable, its nominal characteristic impedance is 50 Ω, and its outer diameter rating of dielectric is 22 mm (7/8").

5.2 Variant

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

a) Type

U – uniformly radiating type cable

The type of non-uniformly radiating type cable is omitted.

b) a dash symbol

c) Sheath material

PE – polyethylene

LSZH – low smoke zero halogen polyolefin

PVC – polyvinyl chloride

d) a dash symbol

e) Outer conductor material and construction

C – copper tape wrapped longitudinally with slots or wrapped helically with gaps

AL – aluminium tape wrapped longitudinally with slots or wrapped helically with gaps

CT – copper corrugated tube with slots

ALT – aluminium corrugated tube with slots

W – copper wires wrapped helically with gaps or braided with low coverage factor

Example: 50-42 (1 5/8") U—LSZH-C is one variant of type 50-42 (1 5/8") radiating cable. It is a uniformly radiating type cable, its sheath material is low smoke zero halogen polyolefin, and its outer conductor is copper tape wrapped longitudinally with slots.

6 Standard rating and characteristics

6.1 Nominal characteristic impendence

The nominal characteristic impedance shall be specified in the detail specification. Typical impedance should be 50 Ω and 75 Ω.

6.2 Rated temperature range

The ~~operational, storage, and installation~~ rating temperature range shall be specified in Table 1 or in the detail specification.

Table 1 – Rated temperature

Parameter	LSZH sheath °C	PE sheath °C	PVC sheath °C
Operational temperature range	−25 to 70	−40 to 70	−15 to 70
Storage temperature range	−25 to 70	−40 to 70	−15 to 70
Installation temperature range	−15 to 60	−30 to 60	0 to 60

6.3 Operating frequency

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

Table 2 – Operating frequency

Type	Maximum recommended frequency GHz	Cut-off frequency GHz
50-9	6,00	12,79
50-12	6,00	9,14
50-22	4,80	5,18
50-32	3,60	3,71
50-42	2,70	2,78
NOTE The cut-off frequency is calculated under the condition that the effective dielectric constant of the dielectric is 1,25. The change of the product structure dimension in the manufacturing process will also affect the change of the cut-off frequency.		

6.4 Stop frequency band

The stop frequency band shall be specified in the detail specification and shall not be used.

6.5 Radiating characteristics 5

Except for uniformly radiating type cables, the radiating characteristics of cables are evaluated by the coupling loss; when required, radiating characteristics can also be evaluated by the coupling loss or radiation intensity around circumferential orientation of radiating cables, see Annex A and Annex B.

The coupling loss measured by the three orthogonal antenna orientations $L_{c,\,x}$, $L_{c,\,y}$, $L_{c,\,z}$, and their average value can also evaluate the electromagnetic field radiation characteristics of the radiating cable.

The radiation characteristics of the uniformly radiating type cable shall be evaluated by cable link loss.

The coupling characteristics between the radiating cable and the mobile terminal also depend on the distance between them (if not 2 m). It characterizes the decline degree of the radiation field intensity with distance.

7 Identification, marking and labelling

7.1 Cable identification

IEC 61196-1:2005, 6.1 applies.

7.2 Cable marking

The cable marking shall be applied to the sheath. The marking shall consist of the IEC cable type number as given in ~~6.1.1 of~~ IEC 61196-1:2005, 6.2 and/or the manufacturer's designated marking when specified in the detail specification.

When applicable, the marking of the installation or radiating direction shall be specified in the detail specification.

The uniformly distributing radiation cable should be provided with an indicator that can indicate the direction of the signal transmission, from the transceiver end of the cable to the load end. 6

7.3 Labelling

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

8 ~~Tests~~ Requirements of finished cables

8.1 General

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 5 of~~ IEC 60068-1:2013, Clause 4.

Applicable test methods shall be in accordance with IEC 61196-1-100, IEC 61196-1-200, IEC 61196-1-300 according to Clause 2 and other test methods specified herein.

8.2 Electrical ~~testing~~ requirement of the finished cable (see Table 3)

Table 3 – Electrical ~~testing~~ requirement

No.	Test procedure	Parameter	Requirements/Remarks
8.2.1	IEC 61196-1-110 ~~(Under consideration)~~	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	When required, value in accordance with the detail specification.
8.2.3	IEC 61196-1-103	~~Test for capacitance~~ Capacitance	When required, value in accordance with the detail specification.
8.2.4	IEC 61196-1-105	Withstand voltage of dielectric	~~Value in accordance with the detail specification~~ Unless otherwise specified in the detailed specification, 3/8",1/2": DC 6 kV,1 min; 7/8",1 1/4": DC 10 kV,1 min; 1 5/8": DC 15 kV,1 min;
8.2.5	~~IEC 61196-1-106 (or~~ IEC 62230~~)~~	~~Withstand voltage of sheath (or spark test)~~ Spark voltage of sheath	Value in accordance with the detail specification.
8.2.6	IEC 61196-1-102	Insulation resistance	Unless specified in detail specification, ≥ 10^4 MΩ·km
8.2.7	IEC 61196-1-108	Mean characteristic impedance	~~Value in accordance with the detail specification~~ (50 ± 2) Ω or (75 ± 2) Ω
8.2.8	IEC 61196-1-112	Return loss	~~Value in accordance with the detail specification. Return loss shall be measured on an uncoiled cable (see Annex A).~~ Specimen length:50 m. During the test, the cable should be uncoiled and installed on a test setup according to IEC 61196-1-124. If not otherwise specified, the return loss should meet the following requirements in the actual working frequency band of the cable. ≥17,7 dB (10 MHz to 2 200 MHz) ≥14,9 dB (2 200 MHz to 4 000 MHz) ≥14,0 dB (4 000 MHz to 6 000 MHz)
8.2.9	~~Annex A~~ IEC 61196-1-123	Attenuation constant/ insertion loss **7**	For a non-uniformly radiating type cable, its attenuation constant shall be in accordance with the detail specification. Value in accordance with the detail specification.
8.2.10	~~Annex B~~ IEC 61196-1-124	Coupling loss (not applicable to uniformly radiating type cable)	Value in accordance with the detail specification
~~7.2.10~~	~~Annexes C and D~~	~~Radiating characteristics~~	~~In addition to the coupling loss specified in Annex B, when required, radiating characteristics may also be evaluated by testing the cable according to Annexes C and D, for assessing the radiating pattern.~~
8.2.11	IEC 61196-1-127[4]	Link loss	Value in accordance with the detail specification

[4] Under consideration.

8.3 Environmental ~~testing~~ requirement (see Table 4)

Table 4 – Environmental ~~testing~~ requirement

No.	Test procedure	Parameter	Requirements/remarks
8.3.1	IEC 61196-1-215 ~~(Under consideration)~~	Ageing	~~Unless otherwise specified~~ When applicable, the temperature value is: ~~200 °C ± 5 °C (FEP sheath)~~ 98 °C ± 2 °C (PVC sheath) 90 °C ± 2 °C (LSZH and PE sheath) Duration: 168 h or specified in the detail specification. Requirements after ageing and cooling down to room temperature: a) No cracks in the elements of cable. b) No black spots in the outer conductor.
8.3.2	IEC 61196-1-201	Cold bend performance	No physical damages of conductors, dielectric and sheaths. The return loss shall remain within the specified limits in Table 3 after the cable returns to room temperature.
8.3.3	IEC 60068-2-61	Climatic sequence – method 1	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 Table 3. Insulation resistance shall be within specified limits in Table 3.
8.3.4	IEC 60811-406	~~Resistance to~~ Environmental stress cracking	No physical damages shall be visible in the cable.

8.4 Mechanical ~~testing~~ requirement (see Table 5)

Table 5 – Mechanical ~~testing~~ requirement

No.	Test methods	Parameter	Requirements/remarks
8.4.1	IEC 61196-1:2005, Subclause 4.2	Visual examination	The sheath shall be free of cracks~~, splits, irregularities, and imbedded foreign material~~, burrs, impurities, or other defects that can affect life, serviceability and appearance. The outer conductor shall be free of black spots or cracks.
8.4.2	IEC 61196-1:2005 Subclause 4.3	Dimensional examination	Value in accordance with the detail specification
8.4.3	IEC 61196-1-301	Ovality of inner conductor	~~When applicable, value in accordance with the detail specification~~ ≤ 7 %
~~7.4.4~~	~~IEC 61196-1-301~~	~~Ovality of outer conductor~~	~~When applicable, value in accordance with the detail specification~~
8.4.4	IEC 61196-1-301	Ovality of dielectric	~~Value in accordance with the detail specification~~ ≤ 7 %
8.4.5	IEC 61196-1-302	Eccentricity of dielectric	~~Value in accordance with the detail specification~~ ≤ 8 %
8.4.6	IEC 61196-1-302	Eccentricity of sheath	~~When applicable, value in accordance with the detail specification~~ ≤ 43 %
8.4.7	IEC 61196-1-314:2015	Cable bending ~~under tension~~	~~Clause 8 of IEC 61196-1-314 shall be used with the details specified herein or in the detail specification:~~ ~~1) length of the cable and length bent under tension;~~ ~~2) radius, R, of rollers / cylinders / mandrels;~~ ~~3) distance, Y;~~ ~~4) bending angle, grad;~~ ~~5) moving speed;~~ ~~6) number of moving cycles:1;~~ ~~7) tensile load.~~ ~~Requirements:~~ ~~• The maximum impedance irregularity shall be within the specified limit (test procedure under study) [a]~~ ~~• No physical damage in cable elements~~ Subclause 4.3.2 and 4.3.3, procedure 2 shall be used with the details specified herein or in the detail specification: 1) radius, R, of mandrel: 10 times the maximum outer diameter of the cable; 2) number of cycles: 3. Requirements: • The return loss shall remain within the specified limits in Table 3. • No physical damage in cable elements
8.4.8	IEC 61196-1-317	Crush resistance of cable	When applicable, the load shall be specified in the detail specification, applied for 2 min. After a 2 min recovery time~~, the maximum impedance irregularity shall be within the specified limit (test procedure under study). [a]~~ ~~No physical damage of the sheath or jacket.~~ • The return loss shall remain within the specified limits in Table 3. • No physical damage in cable elements.

8.4.9	IEC 61196-1-313	Adhesion of dielectric	≥ 98 N, or specify the required value in the detailed specification. L = 75 mm ± 2 mm
8.4.10	IEC 60811-502	Shrinkage for insulations	≤ 6,4 mm a) Test temperature:115 °C ± 2 °C; b) Time:4 h, cooling down to standard atmospheric conditions
8.4.11	IEC 61196-1-316	Maximum pulling force of cable	The maximum pulling force applied shall be specified in the detailed specification. Requirements: • The return loss shall remain within the specified limits in Table 3. • No physical damage in cable elements.
~~[a] Test method according to IEC 61196-1-115 is not applicable for radiating cables. Radiating cables have apertures in the outer conductor which by default create impedance discontinuities. The level of impedance change caused by an aperture depends on its shape and size.~~			

8.5 Fire performance ~~testing~~ requirement (see Table 6)

8.5.1 When intended to be installed in buildings, these cables ~~may fall under~~ can be separately subject to the requirements of local, regional or governmental regulations for fire and safety standards.

8.5.2 When not subject to regulation, fire performance testing ~~may~~ can be performed according to Table 6.

Table 6 – Fire performance ~~testing~~ requirement

No.	Test procedure	Parameter	Requirements/Remarks
8.5.2.1	IEC 60332-1-2	Flame propagation	When required, according to the detail specification.
8.5.2.2	IEC 60754-1	Halogen acid gas emission	When required, according to the detail specification.
8.5.2.3	IEC TS 60695-7-50 IEC TS 60695-7-51	Toxic gas emission	When required, according to the detail specification.
8.5.2.4	IEC 61034-2	Smoke density	When required, according to the detail specification.

NOTE For more information on fire performance testing, refer to IEC TR 62222.

9 Quality assessment

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

10 Delivery and storage

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

Annex A
(normative)

Attenuation constant

A.1 Procedure

A.1.1 General

Measurements can be carried out by one of the two methods, where the free-space method shall be the arbitration method when there is an argument:

– ground-level method;

– free-space method.

A.1.2 Ground-level method

The arrangement of the cable is given in Figure A.1. The cable is laid on non-metallic spacers which gives the cable a distance from the concrete floor of 10 cm to 12 cm.

The cable shall be at least of the length 10 λ, where λ is the cable wavelength of the measuring frequency, but not shorter than 50 m.

A.1.3 Free-space method

The arrangement of the cable is given in Figure A.2. The cable is laid on non-metallic posts at a height of 1,5 m to 2 m.

The cable shall be at least of the length 10 λ, where λ is the cable wavelength of the measuring frequency, but not shorter than 50 m.

A.2 Measurement (see Figures A.1 and A.2)

Adjust the signal generator frequency and record the output power level with a spectrum analyser or equivalent. If the source is built into the measurement device, a cable of known attenuation can be used to connect the far end of the cable (output port B).

Feed the signal to port A of the cable and record the power level at port B.

The nominal characteristic impedance of the cable shall be matched to the nominal impedance of the test set-up.

A.3 Evaluation

Compute attenuation constant as:

$$\alpha = \frac{N_e - N_s}{L} \times 100 \qquad \text{(A.1)}$$

where

α is the attenuation constant, in dB/100 m;

N_e is the power level at cable input (port A), in dBm;

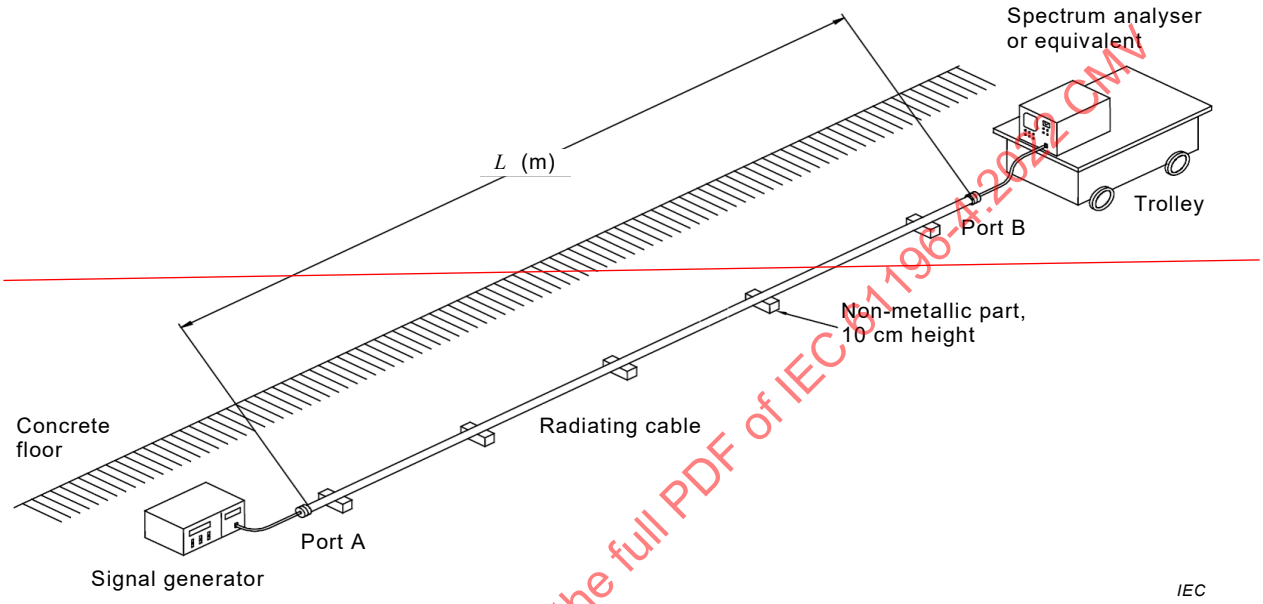
~~N_s is the power level at cable end (port B), in dBm;~~

~~L is the length of the cable, in m.~~

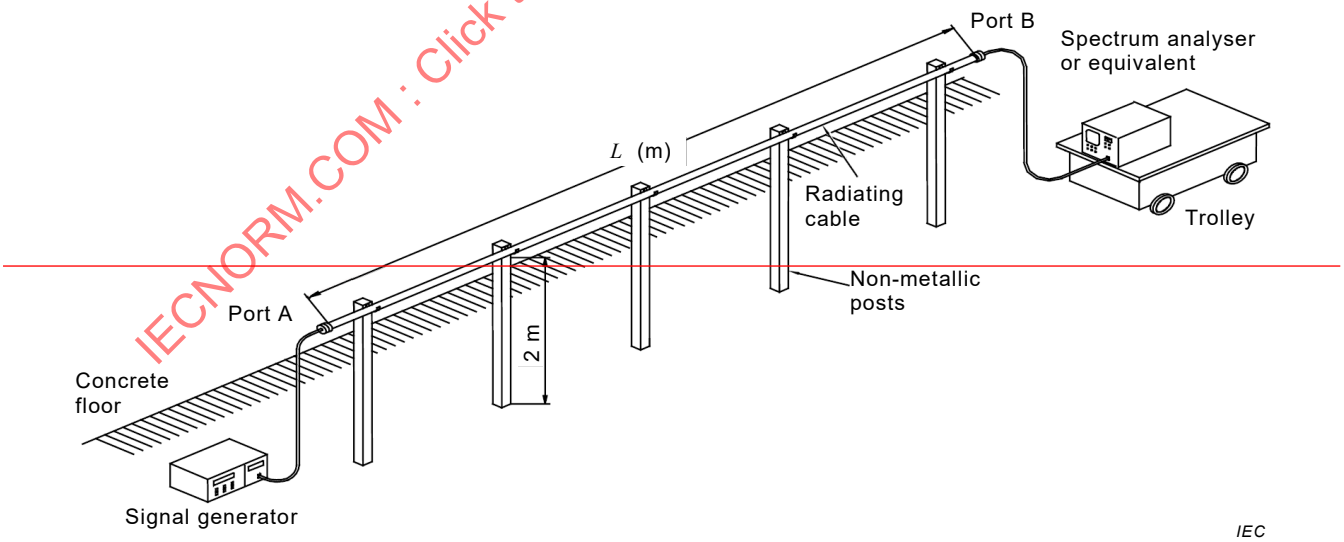
~~NOTE Since resistive loss and coupling loss are both present, α cannot be corrected for the temperature.~~

~~A.4 Requirement~~

~~The attenuation constant shall not be higher than the values specified in the detail specification.~~



~~Figure A.1 – Attenuation constant with ground-level method~~



~~Figure A.2 – Attenuation constant with free-space method~~

~~Annex B~~
~~(normative)~~

~~Coupling loss (far field)~~

~~B.1 Procedure~~

~~B.1.1 General~~

~~Measurements can be carried out by one of the two methods, where the free-space method shall be the arbitration methods when there is an argument:~~

~~– ground-level method;~~

~~– free-space method.~~

~~B.1.2 Ground-level method~~

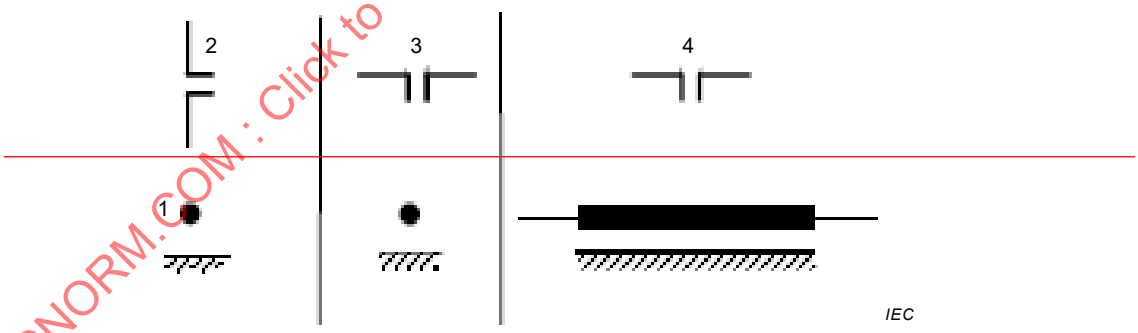
~~The arrangement of the cable is given in Figure B.1. The cable is laid on non-metallic spacers which give the cable a distance from the concrete floor of 10 cm to 12 cm.~~

~~The cable shall be at least of the length 10 λ and not less than 50 m, where λ is the cable wavelength of the measuring frequency.~~

~~The antenna is fixed to a trolley and moved along the cable, the centre of the antenna positioned vertically above the cable at a distance of about 2 m (or the distance which user requests). Preferably a half-wavelength dipole shall be used.~~

~~NOTE Additional distances may be added in the detail specification.~~

~~The spatial orientation of the antenna shall be as specified in the detail specification.~~



~~Key~~

~~1 cable~~
~~2 radial~~
~~3 orthogonal~~
~~4 parallel~~

~~Figure B.1 – Antenna orientations with ground-level method~~

~~B.1.3 Free-space method~~

~~The arrangement of the cable is given in Figure B.2. The cable is laid on non-metallic posts at a height of 1,5 m to 2 m.~~

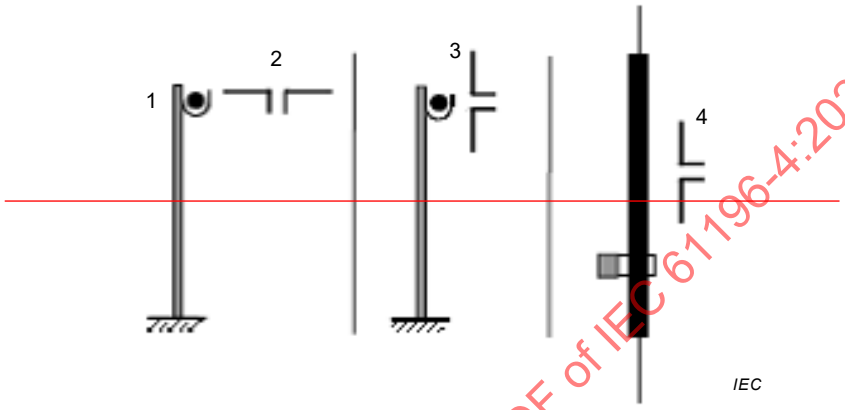
~~The cable shall be at least of the length 10 λ and not less than 50 m, where λ is the cable wavelength of the measuring frequency.~~

The antenna is put on a trolley and moved parallel to the cable. The height of the antenna centre shall be the same as that of the cable and its horizontal distance from the cable shall be about 2 m (see note in B.1.2). Preferably a half-wavelength dipole shall be used. Type and gain of antenna used shall be stated in the test report.

No other metallic parts than the cable and the antenna shall be included within a cylinder of 2 m (min.) in diameter surrounding the axis of the cable and the centre of the antenna.

The spatial orientation of the antenna shall be as specified in the detail specification.

For basic antenna orientations for a dipole, see Figure B.2.



Key

1 cable
2 radial
3 orthogonal
4 parallel

Figure B.2 – Antenna orientations with free-space method

B.2 Measurement (see Figures B.3 and B.4)

Adjust the generator frequency and output power level.

Feed the signal to port A of the cable.

Record the power level received by the antenna as a function of the distance of the antenna from the input port A of the cable by a spectrum analyser or equivalent.

There should be sufficient local resolution for the measurement to be valid. Therefore, 10 measurements per half-wavelength should be made to calculate the coupling loss for reception probabilities up to 95 %. To calculate higher reception probabilities, a sampling rate of 20 measurements per half-wavelength should be made. If there is an argument the total number of measurement shall not be less than 1 000.

B.3 Evaluation

Compute local coupling loss as:

$$L_c(z) = N_e - N_r(z) - (\alpha \cdot z) - G \qquad \text{(B.1)}$$

where

G is the gain of the antenna;

$L_e(z)$ is the level of local coupling loss from the input end (z) of cable, in dB;

N_e is the power level at the cable input, in dBm;

N_t is the power level at the antenna, in dBm;

α is the attenuation constant, in dB/100 m;

z is the distance from cable input to the antenna, in 100 m.

Cable with periodic structures of radiating apertures create an RF field with a main lobe moving from the feeding end (port A) of the radiating cable to the terminated end (port B) with increasing frequency. The frequency specific lobe angle has to be considered when eliminating end effects from the test results for the statistical evaluation of reception probability.

The measured coupling loss is characterized by two typical figures:

– Coupling loss L_{c50} (median value): 50 % reception probability, 50 % of the measured local values are smaller than this value.

– Coupling loss L_{c95}: 95 % reception probabilities, 95 % of the measured local values are smaller than this value.

Mean value of coupling loss:

If the coupling loss has been measured with three antenna orientations, which are orthogonal to each other, the coupling loss can be given as the mean value of the measuring results.

As the coupling loss is a logarithmic figure, the mean coupling loss is derived from the absolute figures of the three antenna orientations:

$$L_{c,mean} = -10 \cdot \log\left(\frac{1}{3}\left(10^{-\frac{L_{c,1}}{10}} + 10^{-\frac{L_{c,2}}{10}} + 10^{-\frac{L_{c,3}}{10}}\right)\right) \quad \text{(B.2)}$$

where

$L_{c,1}$, $L_{c,2}$ and $L_{c,3}$ are the coupling losses for the three orthogonal antenna orientations, in dB.

B.4 Requirement

The characteristic values of coupling loss for a given reception probability shall not exceed the values specified in the detail specification.

B.5 Test report

Test report shall give the following information:

a) test sample length;

b) test temperature;

c) test method;

d) antenna type;

e) antenna gain;

f) antenna orientation;

g) the distance between antenna and radiating cable (if not 2 m).

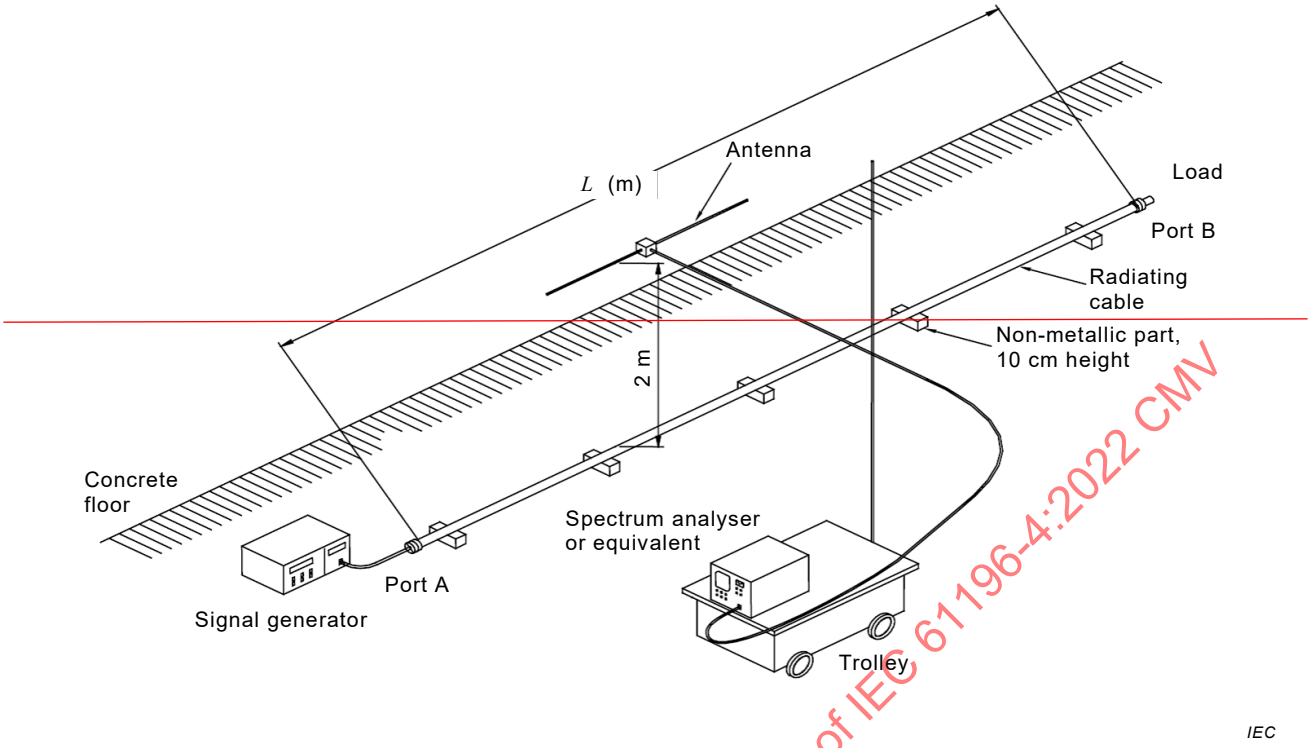


Figure B.3 – Coupling loss with ground-level method

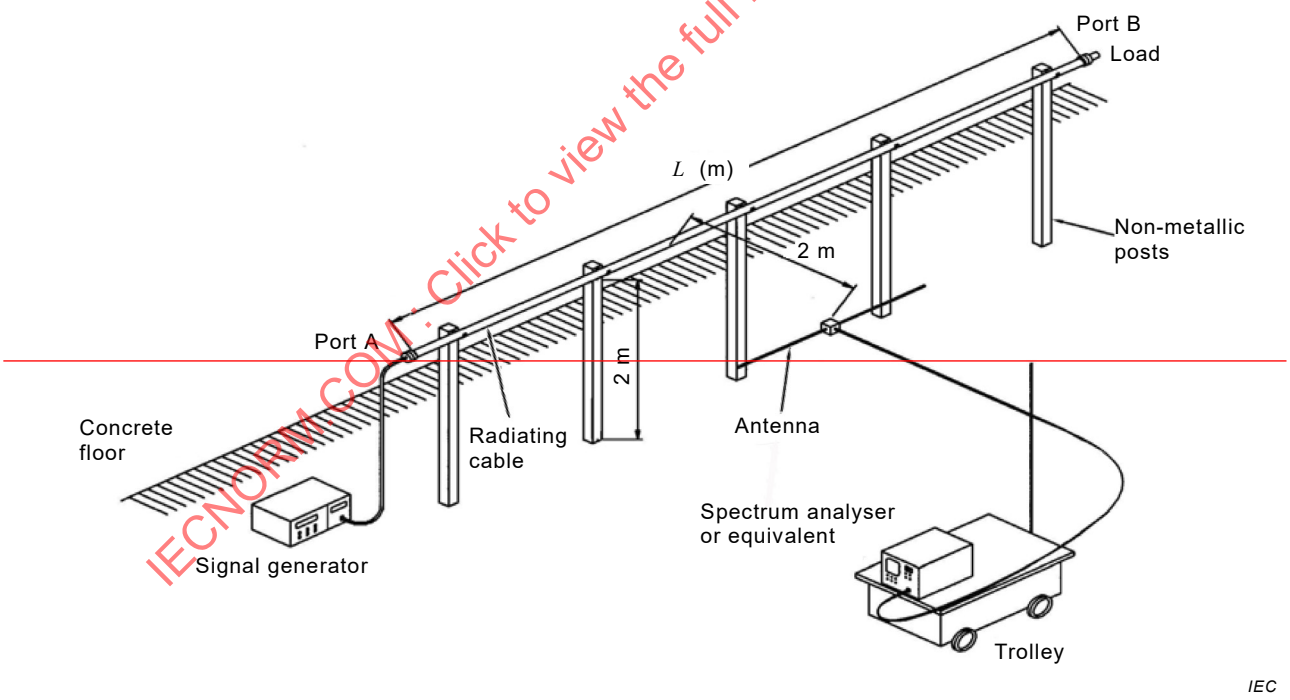


Figure B.4 – Coupling loss with free-space method

Annex A
(informative)

The coupling loss around circumferential orientation of radiating cable

A.1 General

If required, the radiation characteristics of radiating cable around the circumferential orientation (Y-Z) can be evaluated in addition to the coupling loss ~~specified in Annex B~~. Annex A gives a method for evaluating radiating characteristics by the coupling loss around circumferential orientation of radiating cables.

A.2 Terms and definitions

A.2.1
coupling loss chart around circumferential orientation of radiating cable (Y-Z)
chart made of the coupling losses measured around radiating cable in a perpendicular distance

Note 1 to entry: It represents the coupling loss magnitude around radiating cable.

A.2.2 Out-of roundness of coupling loss ~~chart around circumferential orientation of radiating cable~~
difference between the maximum and the minimum coupling loss in a specified angle area φ of the coupling loss chart measured in circumferential orientation

Note 1 to entry: It represents the uniformity of the coupling loss in a specified φ angle area around circumferential orientation, as shown in Formula (A.1).

$$L_{c,o} = \frac{L_{c,max} - L_{c,min}}{2} \quad \text{(A.1)}$$

where

$L_{c,o}$ is the out-of roundness of coupling loss chart around circumferential orientation of radiating cable in angle φ area, in dB;

$L_{c,max}$ is the maximum coupling loss in angle φ area, in dB;

$L_{c,min}$ is the minimum coupling loss in angle φ area, in dB.

A.3 Test method

The radiating cable shall be arranged as in Figure A.1 by using the free-space method.

The cable shall be at least 10 λ long and not less than 50 m, where λ is the cable wavelength of the measuring frequency.

~~Arrangement of cable is the same as Figure B.3.~~

Rotate the radiating cable so that its slots are oriented to the antenna in 0° and measure and calculate the coupling loss $L_{c,\ 0}$ according to ~~Annex B~~ IEC 61196-1-124 (it may be represented in $L_{c50,0}$ in 50 % reception probability or in $L_{c95,\ 0}$ in 95 % reception probability~~, as specified in Clause B.3~~).

Rotate the cable 360° in counter clockwise and measure and calculate the coupling loss $L_{c,\varphi}$ in each 15° interval (or smaller than that) in the same manner as above.

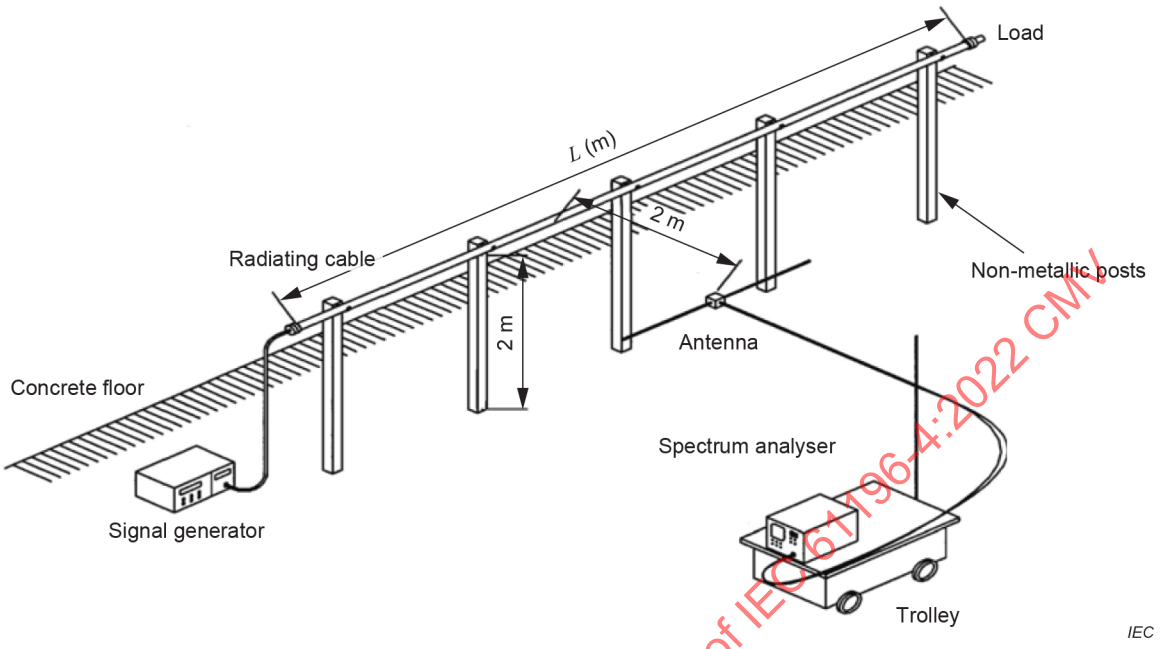
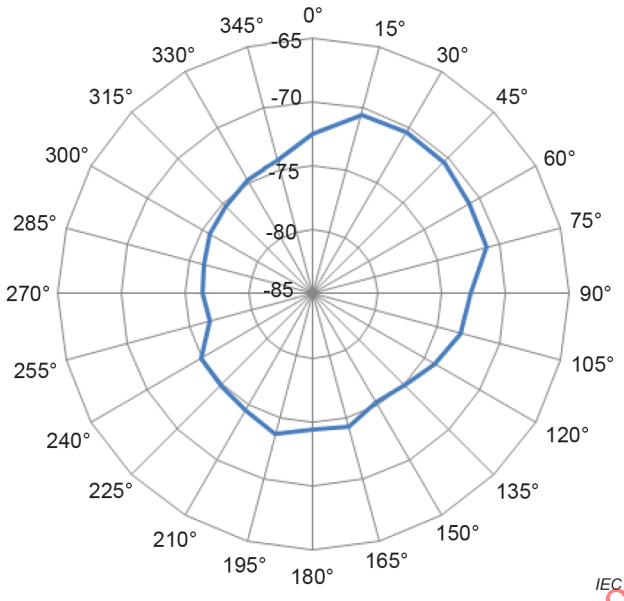


Figure A.1 – Example of testing coupling loss around circumferential orientation of radiating cable (Y-Z)

A.4 Calculation

Draw the chart $L_{c,\varphi}$ ~ φ, as shown in Figure A.2.

Find the maximum coupling loss and minimum coupling loss in a specified φ angle area and calculate the out-of-roundness of coupling loss as shown in Formula (A.1).



Test sample and length: SLR-50-22 (7/8"), 50 m

Test temperature: 26 °C

Test method: free-space method

The orientation of antenna: perpendicularity (y direction)

Test frequency: 900 MHz

The reception probability of coupling loss: 95 %

Figure A.2 – Example of coupling loss chart around circumferential orientation of radiating cable

A.5 Requirements

When required, the coupling loss chart around circumferential orientation and its out-of roundness in specified φ angle area shall be less than the values specified.

A.6 Test report

Test report shall give following information.

a) test sample length;
b) test temperature;
c) test method;
d) antenna type (if not a half-wavelength dipole antenna);
e) antenna gain (if not a half-wavelength dipole antenna);
f) antenna orientation (if a half-wavelength dipole antenna);
g) measuring frequency;
h) distance between antenna and radiating cable (if not 2 m);
i) reception probability of coupling loss.

Annex B
~~(under study)~~ (informative)

~~Radiating~~ Radiation intensity around circumferential orientation of radiating cable

B.1 General

If required, the radiation characteristics of radiating cable around the circumferential orientation (Y-Z) can be evaluated.

Annex B gives a method for evaluating the radiation characteristics by the radiation intensity around the circumferential orientation of radiating cable.

NOTE Most radiating cables are made with periodically arranged apertures building a longitudinal antenna array. The characteristic beam forming requires the superposition of electromagnetic fields generated by multiple groups of apertures. Depending on the frequency band of operation, the periodic ~~structure~~ construction can have a length of several meters. Therefore, the described test method, using a short cable section of only 2 m, is not appropriate to determine the behaviour of a long cable with periodically arranged apertures.

B.2 Terms and definitions

B.2.1
radiation intensity chart around circumferential orientation of radiating cable (Y-Z)
radiation intensity measured around a radiating cable in perpendicular distance, representing the radiation intensity in circumferential orientation

Note 1 to entry: An Example of radiation intensity chart around circumferential orientation of radiating cable is given in Figure B.2.

B.2.2
out-of roundness of radiation intensity chart around circumferential orientation of radiating cable
difference between the maximum and the minimum radiation intensity in a specified angle area φ in the radiation intensity chart around the circumferential orientation

Note 1 to entry: The calculation of the out-of-roundness of radiation intensity chart around circumferential orientation of radiating cable is given in Formula (B.1).

Note 2 to entry: It represents the uniformity of radiation intensity in a specified φ angle area around circumferential orientation, as shown in Formula (B.1).

$$P_o = \frac{P_{max} - P_{min}}{2} \ldots \quad \text{(B.1)}$$

where

P_o is the out-of-roundness of radiation intensity chart around circumferential orientation of radiating cable, in dB;

P_{max} is the maximum radiation intensity in angle φ area, in dBm;

P_{min} is the minimum radiation intensity in angle φ area, in dBm.

B.3 Test method

The radiating cable shall be arranged as in Figure B.1 by using the free-space method and aligning to source antenna in homopolarity. The length of the cable shall not be less than 2 m and the test point shall be in the middle of the sample. It should be done in ~~anechoic chamber when there is an argument~~ a microwave darkroom or free space; in case of doubt, it should be done in a microwave darkroom.

Rotate the radiating cable so that its slots are oriented to the antenna in 0° and measure the ~~radiating~~ radiation intensity P_0.

Rotate the cable 360° in counter clockwise and measure the radiation intensity P_φ in each 5° interval (or smaller than that) in the same manner as above.

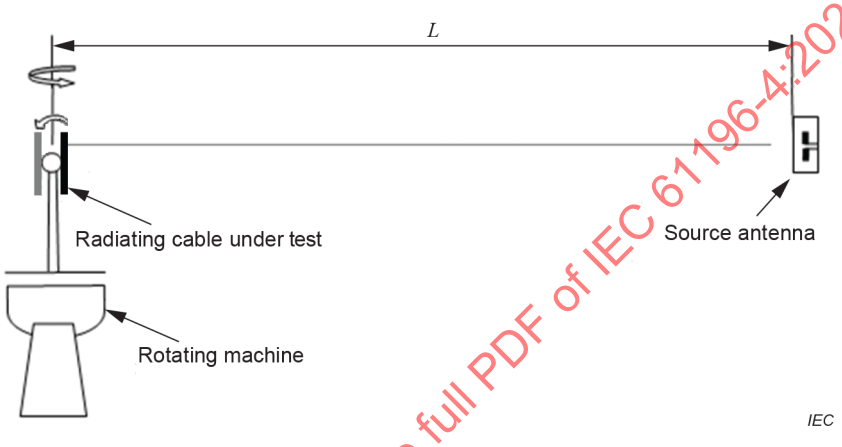
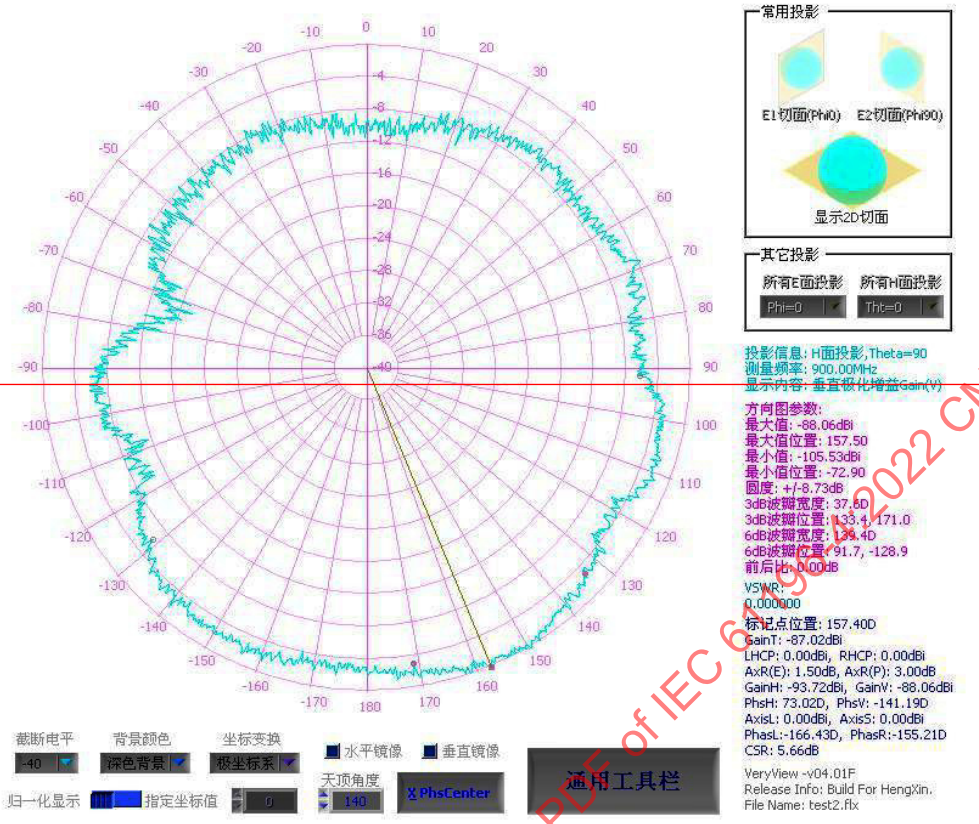


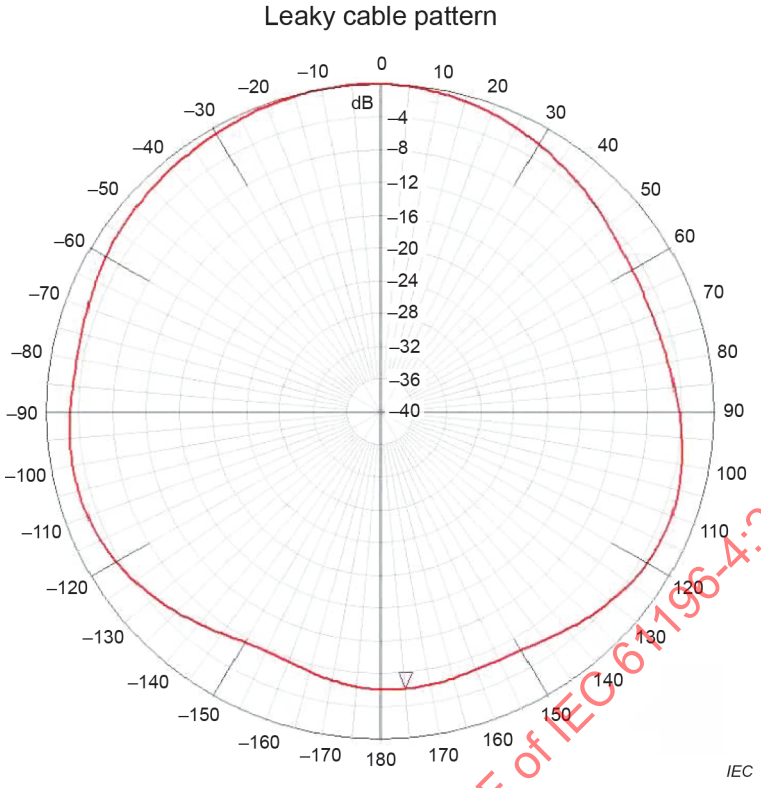
Figure B.1 – Example of testing arrangement of radiation intensity chart around circumferential orientation of radiating cable

B.4 Calculation

Draw the chart P_φ ~ φ, as shown in Figure B.2.

Find the maximum radiation intensity and minimum radiation intensity in a specified φ angle area and calculate the out-of-roundness of ~~radiating~~ radiation intensity as shown in Formula (B.1).





Test sample and length: ~~SLR-50-22(7/8 ")~~ SLR-50-32 (1 1/4"), 2 m

Test temperature: 28 °C

Test method: free space method in ~~an anechoic chamber~~ microwave darkroom

Source of antenna: ~~BBHA9120G~~ double ridge broadband horn antenna

Test frequency: 900 MHz

The distance (L) between radiating cable and antenna: 38 m

Figure B.2 – Example of radiation intensity chart around circumferential orientation of radiating cable

~~NOTE BBHA9120G is a double ridged broadband horn antenna from Schwarzbeck[5].~~

B.5 Requirements

If required, the radiation intensity chart around the circumferential orientation and its out-of-roundness in the specified angle φ shall be within the specified values.

B.6 Test report

Test report shall give following information.

a) test sample length;

b) test temperature;

c) test method;

d) source antenna;

e) measuring frequency;

~~[5] Schwarzbeck is an example of a suitable product available commercially. This information is given for the convenience of users of this standard and does not constitute an endorsement by IEC of this product.~~

f) distance (L) between antenna and radiating cable;

g) testing point in radiating cable (if not in the middle of the cable);

h) circle diagram of radiation field strength in the circumferential direction.

Bibliography

~~IEC 61196-1-209, *Coaxial communication cables – Part 1-209: Environmental test methods – Thermal cycling*[6]~~

~~IEC 61196-1-110, *Coaxial communication cables – Part 1-110: Electrical test methods – Test for continuity*[7]~~

~~IEC 61196-1-215, *Coaxial communication cables – Part 1-215: Environmental test methods – High temperature cable ageing*[8]~~

IEC 61196-1-127[9], *Coaxial communication cables − Part 1-127: Electrical test methods − Link loss of radiating cable*

~~6 Under consideration.~~

~~7 Under consideration.~~

~~8 Under consideration.~~

9 Under consideration.

List of comments

1 A new radiating cable which can radiate electromagnetic energy relatively uniform.

2 Stop frequency band needs to be specified to avoid misuse of the radiating cable.

3 For uniformly radiating type cable, its coupling loss is not a constant along its length and can't be used to evaluate its radiating characteristics. Link loss is a good way to evaluate its radiating characteristics.

4 To unify the type designation and distinguish cables of different types and structures.

5 Different types of radiating cables need to use different parameters to evaluate their radiation characteristics.

6 The uniformly radiating type cable is directional and needs to use an indicator to indicate the direction of signal transmission from the transceiver end of the cable to the load end.

7 For uniformly radiating type cable, its attenuation constant is not a constant and can't be used, but its insertion loss may be needed by users.

_____

IEC 61196-4

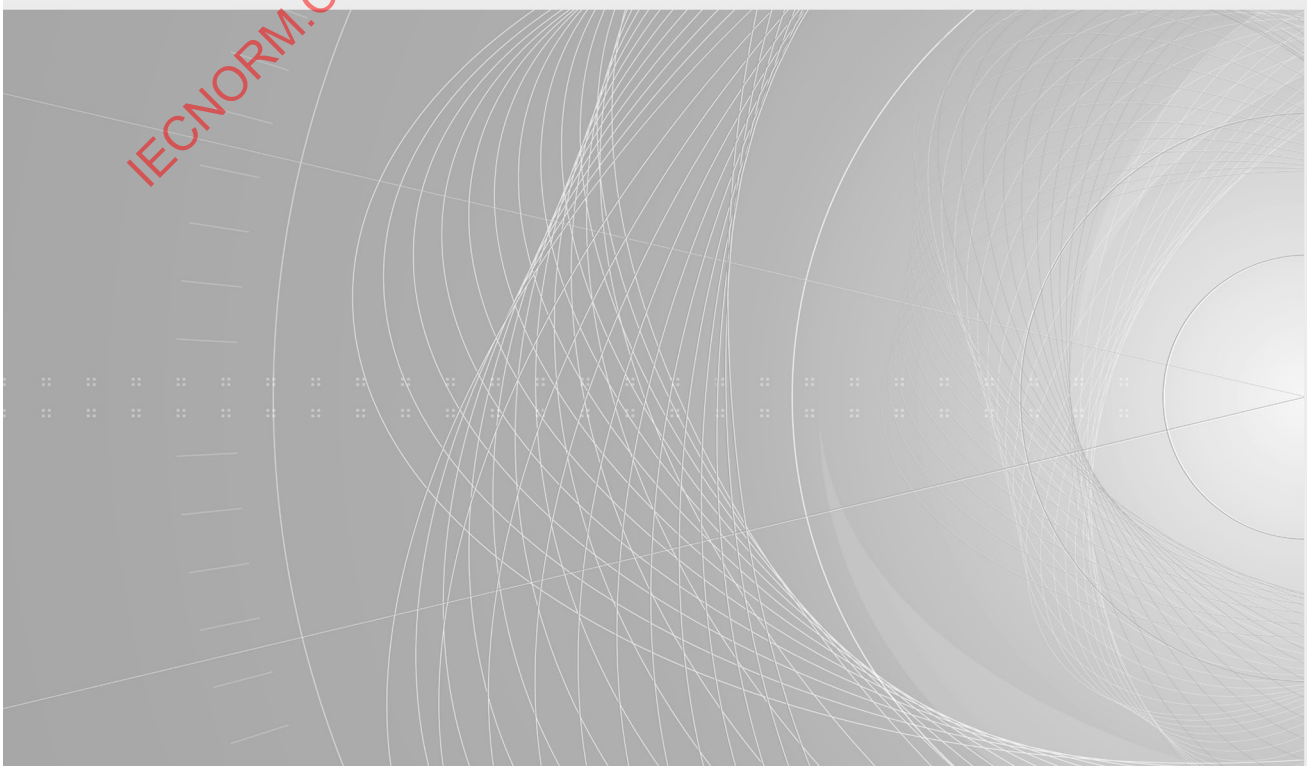
Edition 4.0 2022-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Coaxial communication cables –
Part 4: Sectional specification for radiating cables

Câbles coaxiaux de communication –
Partie 4: Spécification intermédiaire pour câbles rayonnants



IEC 61196-4:2022-09(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

COAXIAL COMMUNICATION CABLES –

Part 4: Sectional specification for radiating cables

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 61196-4 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 fourth edition cancels and replaces the third edition published in 2015. This edition constitutes a technical revision.

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

a) rewrote "1 Scope" to be consistent with other blank detail specifications of coaxial cables;
b) updated different standards in "Clause 2 Normative references";
c) added the definitions of uniformly radiating type cable, stop frequency band and link loss;
d) added different materials and constructions in 4.2 to 4.5;
e) added "Clause 5 IEC type designation";

f) added a detailed rated temperature range of different materials in "6.2 Rated temperature range";

g) added detailed frequencies in "6.3 Operating frequency range";

h) added "6.4 Stop frequency band" and "6.5 Radiating characteristics";

i) added different detail requirements or typical values in 8.2.4, 8.2.7, 8.2.8, 8.4.3 to 8.4.8;

j) deleted "7.4.4 Ovality of outer conductor";

k) added "8.2.11 Link loss", "8.4.9 Adhesion of dielectric", "8.4.10 Shrinkage for insulations", "8.4.11 Maximum pulling force of cable";

l) used IEC 61196-1-123 and IEC 61196-1-124 in the electrical requirements to replace Annex A and Annex B respectively and deleted Annex A and Annex B;

m) added "Figure A.1 Example of testing coupling loss around circumferential orientation of radiating cable (Y-Z)" in Annex A.

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

Draft	Report on voting
46A/1583/FDIS	46A/1598/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/publications.

This part of IEC 61196 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.

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COAXIAL COMMUNICATION CABLES –

Part 4: Sectional specification for radiating cables

1 Scope

This part of IEC 61196 applies to radiating coaxial communication cables, and specifies the terms and definitions, material and construction, IEC type designation, standard rating and characteristics, identification, marking and labelling, requirements of finished cables, quality assessment, delivery and storage, etc. Radiating coaxial communication cables are widely used in wireless communication systems for long, narrow, semi-enclosed and indoor environments, such as high-speed railways, subways, tunnels, and indoor environments.

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 60068-2-61, *Environmental testing – Part 2-61: Test methods: Test Z/ABDM: Climatic sequence*

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 TS 60695-7-50[1], *Fire hazard testing – Part 7-50: Toxicity of fire effluent – Estimation of toxic potency – Apparatus and test method*

IEC TS 60695-7-51[2], *Fire hazard testing – Part 7-51: Toxicity of fire effluent – Estimation of toxic potency – Calculation and interpretation of test results*

IEC 60811-406, *Electric 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*

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1 Withdrawn.

2 Withdrawn.

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 61196-1-100, *Coaxial communication cables – Part 1-100: Electrical test methods – General requirements*

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

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

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

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

IEC 61196-1-108, *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 61196-1-123[3], *Coaxial communication cables – Part 1-123: Electrical test methods – Test for attenuation constant of radiating cable*

IEC 61196-1-124, *Coaxial communication cables – Part 1-124: Electrical test methods – Test for coupling loss of radiating cable*

IEC 61196-1-200, *Coaxial communication cables – Part 1-200: Environmental test methods – General requirements*

IEC 61196-1-201, *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 61196-1-300, *Coaxial communication cables – Part 1-300: Mechanical test methods – General requirements*

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

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3 Under preparation. Stage at the time of publication: IEC/CDV 61196-1-123:2022.

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 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 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 61196-1:2005 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
radiating cable
coaxial communication cable with outer conductor that is intentionally not completely closed, so that part of the electromagnetic wave energy transmitted or received through the cable is coupled by a bidirectional transmission system formed by the outer conductor of the cable and the external environment

Note 1 to entry: The coupling intensity between the cable and mobile equipment depends on:

– the construction of the cable;

– the characteristics of the antenna (such as the type, the orientation, gain, etc.);

– the distance and orientation of the mobile antenna from the cable;

– the nature of ambient atmosphere;

– the operating frequency range;

– the manner of installation of the cable;

– the shape, material and size of surrounding buildings.

3.2
uniformly radiating type cable
radiating cable with its outer conductor intentionally slotted in different slots along the cable, so that electromagnetic energy radiating along the cable is uniform in a specific frequency range

Note 1 to entry: According to the design, the end of the input signal is the transceiver end, and the other is the load end.

3.3
stop frequency band
frequency band at which the peak of attenuation or standing wave appears due the cable construction, such as the slot pitch

Note 1 to entry: Stop frequency band cannot be used to transmit signals.

3.4
coupling loss
L_c
ratio of the power P_t transmitted into the radiating cable at one point to the power P_r received by a half-wavelength dipole antenna located at a distance from the radiating cable at the same point (see formula (1))

$$L_c = 10\log_{10}\frac{P_t}{P_r} \quad (1)$$

where

L_c is coupling loss, in dB;

P_t is the transmission power in the radiating cable at one point, in W;

P_r is the receiving power of the half-wavelength dipole antenna at a distance from the radiating cable at the same point, in W.

Note 1 to entry: Coupling loss is an important parameter of radiating coaxial cables to distinguish them from general coaxial communications cables.

3.5
link loss
ratio of the input power P_{in} transmitted into the transceiver end of the radiating cable from the signal source to the power P_r received by a half-wavelength dipole antenna located at a distance from the radiating cable, expressed by formula (2):

$$L_L = 10\log_{10}\frac{P_{in}}{P_r} \quad (2)$$

where

L_L is the link loss, in dB;

P_{in} is the input power transmitted into the transceiver end of the radiating cable from the signal source, in W;

P_r is the receiving power of the half-wavelength dipole antenna at a distance from the radiating cable, in W.

4 Materials and construction

4.1 General

The cable is composed of the inner conductor, dielectric, outer conductor and sheath; its construction shall be in accordance with 4.2 to 4.5 of this document and the requirements stated in the detail specification.

4.2 Inner conductor

IEC 61196-1:2005, 4.4.1 to 4.4.3 apply.

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

The conductor shall consist of a solid wire, corrugated or smooth tube, or as stated in the detail specification.

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

The inner conductor diameter (and thickness for smooth tube inner conductor) shall be stated in the detail specification.

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

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

4.3 Dielectric

The dielectric material shall be as stated in the detail specification.

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

– solid dielectric;
– air spaced dielectric;
– semi air spaced dielectric (e.g. cellular polymer dielectric).

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

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

9 mm (3/8"), 12 mm (1/2"), 22 mm (7/8"), 32 mm (1 1/4"), 42 mm (1 5/8") or as stated in the detail specification.

4.4 Outer conductor

The outer conductor material shall be plain or coated copper wire, metallic tape with or without slots as stated in the detail specification.

The typical construction of the outer conductor shall be braid with low coverage, or slotted tape(s) rounding, or slotted corrugated tube, or slotted smooth tube, or as stated in the detail specification.

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

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

b) The typical material of sheath shall be PE, LSZH, PVC, etc.

c) The diameter and thickness and tolerance of sheath shall be as stated in the detail specification.

d) For self-supporting cables, the cable design will be an 8-figure design including a messenger wire. The messenger wire position versus the coupling holes will be such that it favours the foreseen radiating pattern.

e) For cables intended for outdoor use or exposed to sunlight, the cable shall pass the UV stability test according to IEC specification.

f) Under the sheath, strips that meet product performance requirements can be permitted, such as non-conductive strips, flame-retardant strips, etc.

5 IEC type designation

5.1 Type name

The type name of the cable includes the nominal characteristic impedance and the 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 millimetres (inch). See Subclause 4.3.

Example: 50-22 (7/8") is a cable, its nominal characteristic impedance is 50 Ω, and its outer diameter rating of dielectric is 22 mm (7/8").

5.2 Variant

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

a) Type

U – uniformly radiating type cable

The type of non-uniformly radiating type cable is omitted.

b) a dash symbol

c) Sheath material

PE – polyethylene

LSZH – low smoke zero halogen polyolefin

PVC – polyvinyl chloride

d) a dash symbol

e) Outer conductor material and construction

C – copper tape wrapped longitudinally with slots or wrapped helically with gaps

AL – aluminium tape wrapped longitudinally with slots or wrapped helically with gaps

CT – copper corrugated tube with slots

ALT – aluminium corrugated tube with slots

W – copper wires wrapped helically with gaps or braided with low coverage factor

Example: 50-42 (1 5/8") U—LSZH-C is one variant of type 50-42 (1 5/8") radiating cable. It is a uniformly radiating type cable, its sheath material is low smoke zero halogen polyolefin, and its outer conductor is copper tape wrapped longitudinally with slots.

6 Standard rating and characteristics

6.1 Nominal characteristic impendence

The nominal characteristic impedance shall be specified in the detail specification. Typical impedance should be 50 Ω and 75 Ω.

6.2 Rated temperature range

The rating temperature range shall be specified in Table 1 or in the detail specification.

Table 1 – Rated temperature

Parameter	LSZH sheath °C	PE sheath °C	PVC sheath °C
Operational temperature range	−25 to 70	−40 to 70	−15 to 70
Storage temperature range	−25 to 70	−40 to 70	−15 to 70
Installation temperature range	−15 to 60	−30 to 60	0 to 60

6.3 Operating frequency

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

Table 2 – Operating frequency

Type	Maximum recommended frequency GHz	Cut-off frequency GHz
50-9	6,00	12,79
50-12	6,00	9,14
50-22	4,80	5,18
50-32	3,60	3,71
50-42	2,70	2,78
NOTE The cut-off frequency is calculated under the condition that the effective dielectric constant of the dielectric is 1,25. The change of the product structure dimension in the manufacturing process will also affect the change of the cut-off frequency.		

6.4 Stop frequency band

The stop frequency band shall be specified in the detail specification and shall not be used.

6.5 Radiating characteristics

Except for uniformly radiating type cables, the radiating characteristics of cables are evaluated by the coupling loss; when required, radiating characteristics can also be evaluated by the coupling loss or radiation intensity around circumferential orientation of radiating cables, see Annex A and Annex B.

The coupling loss measured by the three orthogonal antenna orientations $L_{c,\,x}$, $L_{c,\,y}$, $L_{c,\,z}$, and their average value can also evaluate the electromagnetic field radiation characteristics of the radiating cable.

The radiation characteristics of the uniformly radiating type cable shall be evaluated by cable link loss.

The coupling characteristics between the radiating cable and the mobile terminal also depend on the distance between them (if not 2 m). It characterizes the decline degree of the radiation field intensity with distance.

7 Identification, marking and labelling

7.1 Cable identification

IEC 61196-1:2005, 6.1 applies.

7.2 Cable marking

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

When applicable, the marking of the installation or radiating direction shall be specified in the detail specification.

The uniformly distributing radiation cable should be provided with an indicator that can indicate the direction of the signal transmission, from the transceiver end of the cable to the load end.

7.3 Labelling

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

8 Requirements of finished cables

8.1 General

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 IEC 60068-1:2013, Clause 4.

Applicable test methods shall be in accordance with IEC 61196-1-100, IEC 61196-1-200, IEC 61196-1-300 according to Clause 2 and other test methods specified herein.

8.2 Electrical requirement of the finished cable (see Table 3)

Table 3 – Electrical requirement

No.	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	When required, value in accordance with the detail specification.
8.2.3	IEC 61196-1-103	Capacitance	When required, value in accordance with the detail specification.
8.2.4	IEC 61196-1-105	Withstand voltage of dielectric	Unless otherwise specified in the detailed specification, 3/8",1/2": DC 6 kV,1 min; 7/8",1 1/4": DC 10 kV,1 min; 1 5/8": DC 15 kV,1 min;
8.2.5	IEC 62230	Spark voltage of sheath	Value in accordance with the detail specification.
8.2.6	IEC 61196-1-102	Insulation resistance	Unless specified in detail specification, ≥ 10^4 MΩ·km
8.2.7	IEC 61196-1-108	Mean characteristic impedance	(50 ± 2) Ω or (75 ± 2) Ω
8.2.8	IEC 61196-1-112	Return loss	Specimen length:50 m. During the test, the cable should be uncoiled and installed on a test setup according to IEC 61196-1-124. If not otherwise specified, the return loss should meet the following requirements in the actual working frequency band of the cable. ≥17,7 dB (10 MHz to 2 200 MHz) ≥14,9 dB (2 200 MHz to 4 000 MHz) ≥14,0 dB (4 000 MHz to 6 000 MHz)
8.2.9	IEC 61196-1-123	Attenuation constant/ insertion loss	For a non-uniformly radiating type cable, its attenuation constant shall be in accordance with the detail specification. Value in accordance with the detail specification.
8.2.10	IEC 61196-1-124	Coupling loss (not applicable to uniformly radiating type cable)	Value in accordance with the detail specification
8.2.11	IEC 61196-1-127[4]	Link loss	Value in accordance with the detail specification

[4] Under consideration.

8.3 Environmental requirement (see Table 4)

Table 4 – Environmental requirement

No.	Test procedure	Parameter	Requirements/remarks
8.3.1	IEC 61196-1-215	Ageing	When applicable, the temperature value is: 98 °C ± 2 °C (PVC sheath) 90 °C ± 2 °C (LSZH and PE sheath) Duration:168 h or specified in the detail specification. Requirements after ageing and cooling down to room temperature: a) No cracks in the elements of cable. b) No black spots in the outer conductor.
8.3.2	IEC 61196-1-201	Cold bend performance	No physical damages of conductors, dielectric and sheaths. The return loss shall remain within the specified limits in Table 3 after the cable returns to room temperature.
8.3.3	IEC 60068-2-61	Climatic sequence – method 1	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 Table 3. Insulation resistance shall be within specified limits in Table 3.
8.3.4	IEC 60811-406	Environmental stress cracking	No physical damages shall be visible in the cable.

8.4 Mechanical requirement (see Table 5)

Table 5 – Mechanical requirement

No.	Test methods	Parameter	Requirements/remarks
8.4.1	IEC 61196-1:2005, Subclause 4.2	Visual examination	The sheath shall be free of cracks, burrs, impurities, or other defects that can affect life, serviceability and appearance. The outer conductor shall be free of black spots or cracks.
8.4.2	IEC 61196-1:2005 Subclause 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 61196-1-301	Ovality of dielectric	≤ 7 %
8.4.5	IEC 61196-1-302	Eccentricity of dielectric	≤ 8 %
8.4.6	IEC 61196-1-302	Eccentricity of sheath	≤ 43 %
8.4.7	IEC 61196-1-314:2015	Cable bending	Subclause 4.3.2 and 4.3.3, procedure 2 shall be used with the details specified herein or in the detail specification: 1) radius, R, of mandrel: 10 times the maximum outer diameter of the cable; 2) number of cycles: 3. Requirements: • The return loss shall remain within the specified limits in Table 3. • No physical damage in cable elements
8.4.8	IEC 61196-1-317	Crush resistance of cable	When applicable, the load shall be specified in the detail specification, applied for 2 min. After a 2 min recovery time: • The return loss shall remain within the specified limits in Table 3. • No physical damage in cable elements.
8.4.9	IEC 61196-1-313	Adhesion of dielectric	≥ 98 N, or specify the required value in the detailed specification. L = 75 mm ± 2 mm
8.4.10	IEC 60811-502	Shrinkage for insulations	≤ 6,4 mm a) Test temperature:115 °C ± 2 °C; b) Time:4 h, cooling down to standard atmospheric conditions
8.4.11	IEC 61196-1-316	Maximum pulling force of cable	The maximum pulling force applied shall be specified in the detailed specification. Requirements: • The return loss shall remain within the specified limits in Table 3. • No physical damage in cable elements.

8.5 Fire performance requirement (see Table 6)

8.5.1 When intended to be installed in buildings, these cables can be separately subject to the requirements of local, regional or governmental regulations for fire and safety standards.

8.5.2 When not subject to regulation, fire performance testing can be performed according to Table 6.

Table 6 – Fire performance requirement

No.	Test procedure	Parameter	Requirements/Remarks
8.5.2.1	IEC 60332-1-2	Flame propagation	When required, according to the detail specification.
8.5.2.2	IEC 60754-1	Halogen acid gas emission	When required, according to the detail specification.
8.5.2.3	IEC TS 60695-7-50 IEC TS 60695-7-51	Toxic gas emission	When required, according to the detail specification.
8.5.2.4	IEC 61034-2	Smoke density	When required, according to the detail specification.

NOTE For more information on fire performance testing, refer to IEC TR 62222.

9 Quality assessment

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

10 Delivery and storage

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

Annex A
(informative)

The coupling loss around circumferential orientation of radiating cable

A.1 General

If required, the radiation characteristics of radiating cable around the circumferential orientation (Y-Z) can be evaluated in addition to the coupling loss. Annex A gives a method for evaluating radiating characteristics by the coupling loss around circumferential orientation of radiating cables.

A.2 Terms and definitions

A.2.1
coupling loss chart around circumferential orientation of radiating cable (Y-Z)
chart made of the coupling losses measured around radiating cable in a perpendicular distance

Note 1 to entry: It represents the coupling loss magnitude around radiating cable.

A.2.2
out-of roundness of coupling loss
difference between the maximum and the minimum coupling loss in a specified angle area φ of the coupling loss chart measured in circumferential orientation

Note 1 to entry: It represents the uniformity of the coupling loss in a specified φ angle area around circumferential orientation, as shown in Formula (A.1).

$$L_{c,o} = \frac{L_{c,max} - L_{c,min}}{2} \quad \text{…} \tag{A.1}$$

where

$L_{c,o}$ is the out-of roundness of coupling loss chart around circumferential orientation of radiating cable in angle φ area, in dB;

$L_{c,max}$ is the maximum coupling loss in angle φ area, in dB;

$L_{c,min}$ is the minimum coupling loss in angle φ area, in dB.

A.3 Test method

The radiating cable shall be arranged as in Figure A.1 by using the free-space method.

The cable shall be at least 10 λ long and not less than 50 m, where λ is the cable wavelength of the measuring frequency.

Rotate the radiating cable so that its slots are oriented to the antenna in 0° and measure and calculate the coupling loss $L_{c,0}$ according to IEC 61196-1-124 (it may be represented in $L_{c50,0}$ in 50 % reception probability or in $L_{c95,0}$ in 95 % reception probability).

Rotate the cable 360° in counter clockwise and measure and calculate the coupling loss $L_{c,\varphi}$ in each 15° interval (or smaller than that) in the same manner as above.

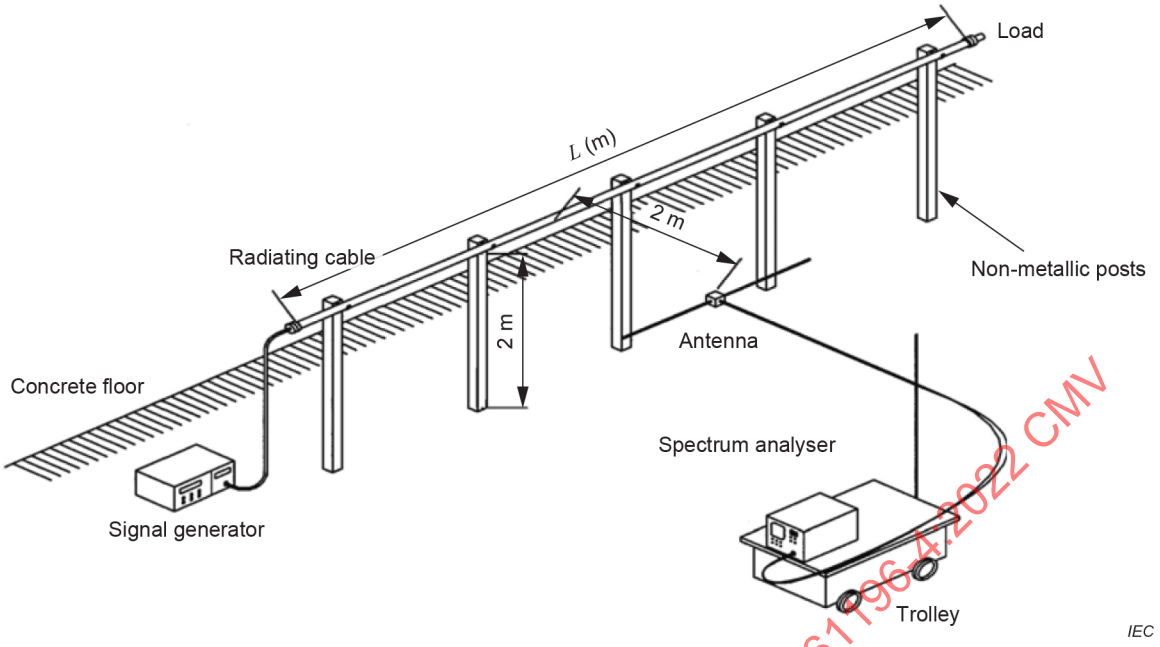
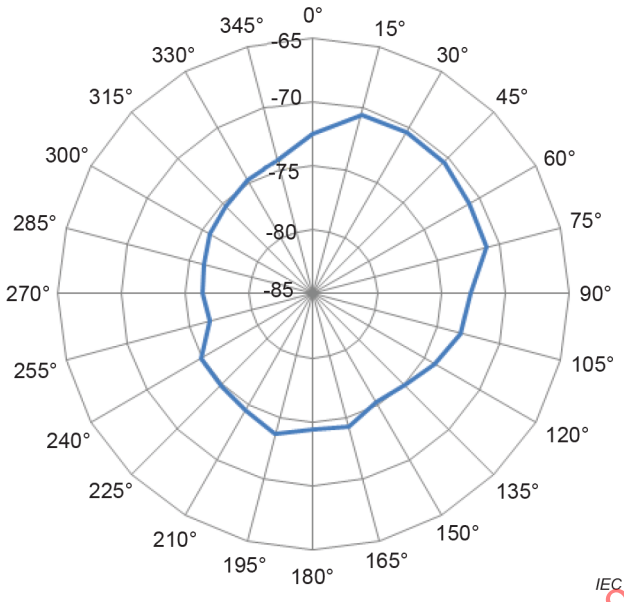


Figure A.1 – Example of testing coupling loss around circumferential orientation of radiating cable (Y-Z)

A.4 Calculation

Draw the chart $L_{c,\varphi}$ ~ φ, as shown in Figure A.2.

Find the maximum coupling loss and minimum coupling loss in a specified φ angle area and calculate the out-of-roundness of coupling loss as shown in Formula (A.1).



Test sample and length: SLR-50-22 (7/8"), 50 m

Test temperature: 26 °C

Test method: free-space method

The orientation of antenna: perpendicularity (y direction)

Test frequency: 900 MHz

The reception probability of coupling loss: 95 %

Figure A.2 – Example of coupling loss chart around circumferential orientation of radiating cable

A.5 Requirements

When required, the coupling loss chart around circumferential orientation and its out-of roundness in specified φ angle area shall be less than the values specified.

A.6 Test report

Test report shall give following information.

a) test sample length;
b) test temperature;
c) test method;
d) antenna type (if not a half-wavelength dipole antenna);
e) antenna gain (if not a half-wavelength dipole antenna);
f) antenna orientation (if a half-wavelength dipole antenna);
g) measuring frequency;
h) distance between antenna and radiating cable (if not 2 m);
i) reception probability of coupling loss.

Annex B
(informative)

Radiation intensity around circumferential orientation of radiating cable

B.1 General

If required, the radiation characteristics of radiating cable around the circumferential orientation (Y-Z) can be evaluated.

Annex B gives a method for evaluating the radiation characteristics by the radiation intensity around the circumferential orientation of radiating cable.

NOTE Most radiating cables are made with periodically arranged apertures building a longitudinal antenna array. The characteristic beam forming requires the superposition of electromagnetic fields generated by multiple groups of apertures. Depending on the frequency band of operation, the periodic construction can have a length of several meters. Therefore, the described test method, using a short cable section of only 2 m, is not appropriate to determine the behaviour of a long cable with periodically arranged apertures.

B.2 Terms and definitions

B.2.1
radiation intensity chart around circumferential orientation of radiating cable (Y-Z)
radiation intensity measured around a radiating cable in perpendicular distance, representing the radiation intensity in circumferential orientation

Note 1 to entry: An Example of radiation intensity chart around circumferential orientation of radiating cable is given in Figure B.2.

B.2.2
out-of roundness of radiation intensity chart around circumferential orientation of radiating cable
difference between the maximum and the minimum radiation intensity in a specified angle area φ in the radiation intensity chart around the circumferential orientation

Note 1 to entry: The calculation of the out-of-roundness of radiation intensity chart around circumferential orientation of radiating cable is given in Formula (B.1).

Note 2 to entry: It represents the uniformity of radiation intensity in a specified φ angle area around circumferential orientation, as shown in Formula (B.1).

$$P_o = \frac{P_{max} - P_{min}}{2} \ldots \quad \text{(B.1)}$$

where

P_o is the out-of-roundness of radiation intensity chart around circumferential orientation of radiating cable, in dB;

P_{max} is the maximum radiation intensity in angle φ area, in dBm;

P_{min} is the minimum radiation intensity in angle φ area, in dBm.

B.3 Test method

The radiating cable shall be arranged as in Figure B.1 by using the free-space method and aligning to source antenna in homopolarity. The length of the cable shall not be less than 2 m and the test point shall be in the middle of the sample. It should be done in a microwave darkroom or free space; in case of doubt, it should be done in a microwave darkroom.

Rotate the radiating cable so that its slots are oriented to the antenna in 0° and measure the radiation intensity P_0.

Rotate the cable 360° in counter clockwise and measure the radiation intensity P_φ in each 5° interval (or smaller than that) in the same manner as above.

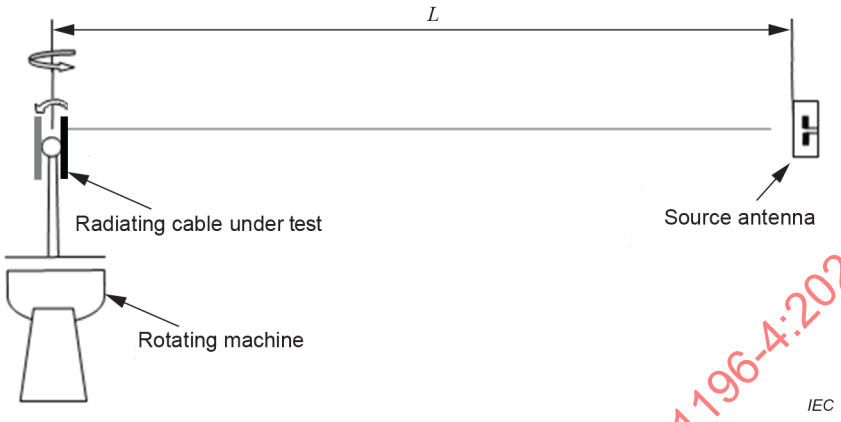
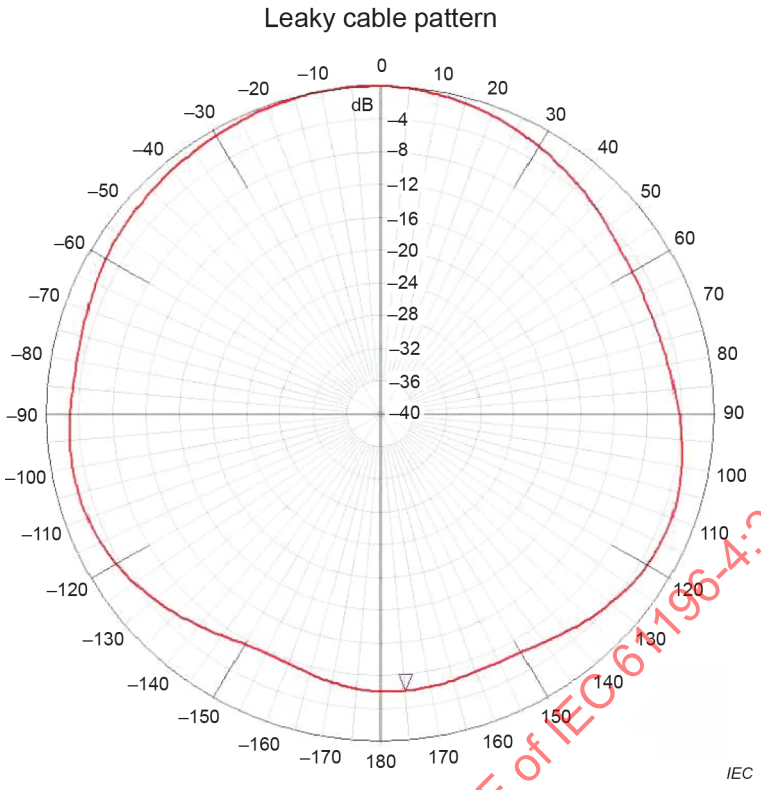


Figure B.1 – Example of testing arrangement of radiation intensity chart around circumferential orientation of radiating cable

B.4 Calculation

Draw the chart P_φ ~ φ, as shown in Figure B.2.

Find the maximum radiation intensity and minimum radiation intensity in a specified φ angle area and calculate the out-of-roundness of radiation intensity as shown in Formula (B.1).



Test sample and length: SLR-50-32 (1 1/4"), 2 m

Test temperature: 28 °C

Test method: free space method in microwave darkroom

Source of antenna: double ridge broadband horn antenna

Test frequency: 900 MHz

The distance (L) between radiating cable and antenna: 38 m

Figure B.2 – Example of radiation intensity chart around circumferential orientation of radiating cable

B.5 Requirements

If required, the radiation intensity chart around the circumferential orientation and its out-of-roundness in the specified angle φ shall be within the specified values.

B.6 Test report

Test report shall give following information.

a) test sample length;
b) test temperature;
c) test method;
d) source antenna;
e) measuring frequency;
f) distance (L) between antenna and radiating cable;
g) testing point in radiating cable (if not in the middle of the cable);
h) circle diagram of radiation field strength in the circumferential direction.

Bibliography

IEC 61196-1-127[5], *Coaxial communication cables − Part 1-127: Electrical test methods − Link loss of radiating cable*

5 Under consideration.

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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CÂBLES COAXIAUX DE COMMUNICATION –

Partie 4: Spécification intermédiaire pour câbles rayonnants

AVANT-PROPOS

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L'IEC 61196-4 a été établie par le sous-comité 46A: Câbles coaxiaux, du comité d'études 46 de l'IEC: Câbles, fils, guides d'ondes, connecteurs, composants passifs pour micro-onde et accessoires. Il s'agit d'une Norme internationale.

Cette quatrième édition annule et remplace la troisième édition parue en 2015. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) réécriture de "1 Domaine d'application" pour assurer la cohérence avec les autres spécifications particulières-cadres des câbles coaxiaux;
b) mise à jour de différentes normes à l'Article "2 Références normatives";

c) ajout des définitions de câble de type uniformément rayonnant, bande de fréquences d'arrêt et perte de liaison;

d) ajout de différents matériaux et de différentes constructions en 4.2 à 4.5;

e) ajout de l'Article "5 Désignation de type IEC";

f) ajout d'une plage de températures assignée détaillée de différents matériaux en "6.2 Plage de températures assignée";

g) ajout de fréquences détaillées en "6.3 Bande de fréquences opérationnelles";

h) ajout de "6.4 Bande de fréquences d'arrêt" et "6.5 Caractéristiques de rayonnement";

i) ajout de différentes exigences détaillées ou de valeurs types en 8.2.4, 8.2.7, 8.2.8, 8.4.3 à 8.4.8;

j) suppression de "7.4.4 Ovalité du conducteur extérieur";

k) ajout de "8.2.11 Perte de liaison", "8.4.9 Adhérence du diélectrique", "8.4.10 Rétraction des enveloppes isolantes", "8.4.11 Force de traction maximale du câble";

l) utilisation de l'IEC 61196-1-123 et de l'IEC 61196-1-124 dans les exigences électriques pour remplacer les Annexes A et B, respectivement, et suppression des Annexes A et B;

m) ajout de la "Figure A.1 Exemple d'essai d'affaiblissement de couplage autour de l'orientation circonférentielle du câble rayonnant (Y-Z)" dans l'Annexe A.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
46A/1583/FDIS	46A/1598/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

La présente partie de l'IEC 61196 doit être lue conjointement avec l'IEC 61196-1:2005.

Une liste de toutes les parties de la série IEC 61196, publiées sous le titre général *Câbles coaxiaux de communication*, se trouve sur le site web de l'IEC.

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CÂBLES COAXIAUX DE COMMUNICATION –

Partie 4: Spécification intermédiaire pour câbles rayonnants

1 Domaine d'application

La présente partie de l'IEC 61196 s'applique aux câbles de communication coaxiaux rayonnants et spécifie les termes et définitions, les matériaux et la construction, la désignation de type IEC, les valeurs normalisées et les caractéristiques, l'identification, le marquage et l'étiquetage, les exigences des câbles finis, l'évaluation de la qualité, la livraison et le stockage, etc. Les câbles de communication coaxiaux rayonnants sont largement utilisés dans les systèmes de communication sans fil destinés aux environnements longs, étroits, semi-fermés et intérieurs, tels que les lignes ferroviaires à grande vitesse, les souterrains, les tunnels et les environnements intérieurs.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-1:2013, *Essais d'environnement – Partie 1: Généralités et lignes directrices*

IEC 60068-2-61, *Essais d'environnement – Partie 2-61: Méthode d'essai: Essai Z/ABDM: Séquence climatique*

IEC 60332-1-2, *Essais des câbles électriques et à fibres optiques soumis au feu – Partie 1-2: Essai de propagation verticale de la flamme sur conducteur ou câble isolé – Procédure pour flamme à prémélange de 1 kW*

IEC 60754-1, *Essai sur les gaz émis lors de la combustion des matériaux prélevés sur câbles – Partie 1: Détermination de la quantité de gaz acide halogéné*

IEC TS 60695-7-50[1], *Essais relatifs aux risques du feu – Partie 7-50: Toxicity of fire effluent – Estimation of toxic potency – Apparatus and test method (disponible en anglais seulement)*

IEC TS 60695-7-51[2], *Essais relatifs aux risques du feu – Partie 7-51: Toxicité de l'effluent du feu – Estimation de la puissance toxique – Calcul et interprétation des résultats d'essai*

IEC 60811-406, *Câbles électriques et à fibres optiques – Méthodes d'essai pour les matériaux non-métalliques – Partie 406: Essais divers - Résistance des mélanges polyéthylène et polypropylène aux craquelures*

IEC 60811-502, *Câbles électriques et à fibres optiques – Méthodes d'essai pour les matériaux non-métalliques – Partie 502: Essais mécaniques − Essai de rétraction des enveloppes isolantes*

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1 Retirée.

2 Retirée.

IEC 61034-2, *Mesure de la densité de fumées dégagées par des câbles brûlant dans des conditions définies – Partie 2: Procédure d'essai et prescriptions*

IEC 61196-1:2005, *Câbles coaxiaux de communication – Partie 1: Spécification générique – Généralités, définitions et exigences*

IEC 61196-1-1, *Câbles coaxiaux de communication – Partie 1-1 Agrément de savoir-faire pour câbles coaxiaux*

IEC 61196-1-100, *Câbles coaxiaux de communication – Partie 1-100: Méthodes d'essais électriques – Exigences générales*

IEC 61196-1-101, *Câbles coaxiaux de communication – Partie 1-101: Méthodes d'essais électriques – Essai de la résistance en courant continu des conducteurs des câbles*

IEC 61196-1-102, *Câbles coaxiaux de communication – Partie 1-102: Méthodes d'essais électriques – Essai pour la résistance d'isolation du diélectrique du câble*

IEC 61196-1-103, *Câbles coaxiaux de communication – Partie 1-103: Méthodes d'essais électriques – Essais sur la capacité du câble*

IEC 61196-1-105, *Câbles coaxiaux de communication – Partie 1-105: Méthodes d'essais électriques – Essai pour la tension d'épreuve du diélectrique du câble*

IEC 61196-1-108, *Câbles coaxiaux de communication – Partie 1-108: Méthodes d'essais électriques –Essai de l'impédance caractéristique, du retard de phase et de groupe, de la longueur électrique et de la vitesse de propagation*

IEC 61196-1-110, *Coaxial communication cables – Part 1-110: Electrical test methods –Test for continuity (disponible en anglais seulement)*

IEC 61196-1-112, *Câbles coaxiaux de communication – Partie 1-112: Méthodes d'essai électrique – Essai de l'affaiblissement de réflexion (uniformité d'impédance)*

IEC 61196-1-123[3], *Coaxial communication cables – Part 1-123: Electrical test methods –Test for attenuation constant of radiating cable (disponible en anglais seulement)*

IEC 61196-1-124, *Coaxial communication cables – Part 1-124: Electrical test methods –Test for coupling loss of radiating cable (disponible en anglais seulement)*

IEC 61196-1-200, *Câbles coaxiaux de communication – Partie 1-200: Méthodes d'essais d'environnement – Exigences générales*

IEC 61196-1-201, *Coaxial communication cables – Part 1-201: Environmental test methods – Test for cold bend performance of cable (disponible en anglais seulement)*

IEC 61196-1-215, *Coaxial communication cables – Part 1-215: Environmental test methods – High temperature cable ageing (disponible en anglais seulement)*

IEC 61196-1-300, *Coaxial communication cables – Part 1-300: Mechanical test methods – General requirements (disponible en anglais seulement)*

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3 En cours d'élaboration. Stade au moment de la publication: IEC/CDV 61196-1-123:2022.

IEC 61196-1-301, *Câbles coaxiaux de communication – Partie 1-301: Méthodes d'essais mécaniques – Essai d'ovalité*

IEC 61196-1-302, *Câbles coaxiaux de communication – Partie 1-302: Méthodes d'essais mécaniques – Essai d'excentricité*

IEC 61196-1-313, *Coaxial communication cables – Part 1-313: Mechanical test methods – Adhesion of dielectric and sheath (disponible en anglais seulement)*

IEC 61196-1-314:2015, *Coaxial communication cables – Part 1-314: Mechanical test methods –Test for bending (disponible en anglais seulement)*

IEC 61196-1-316, *Câbles coaxiaux de communication – Partie 1-316: Méthodes d'essais mécaniques – Essai de force de traction maximale du câble*

IEC 61196-1-317, *Câbles coaxiaux de communication – Partie 1-317: Méthodes d'essai mécanique – Essai de résistance à l'écrasement des câbles*

IEC TR 62222, *Fire performance of communication cables installed in buildings* (disponible en anglais seulement)

IEC 62230, *Câbles électriques – Méthode d'essai au défilement à sec (Sparker)*

3 Termes et définitions

Pour les besoins du présent document, les termes et les définitions de l'IEC 61196-1:2005 ainsi que les suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
câble rayonnant
câble coaxial de communication à conducteur extérieur qui n'est volontairement pas complètement fermé, pour qu'une partie de l'énergie électromagnétique transmise ou reçue à travers le câble soit couplée par un système de transmission bidirectionnel formé par le conducteur extérieur du câble et le milieu extérieur

Note 1 à l'article: L'intensité du couplage entre le câble et l'équipement mobile dépend:

– de la construction du câble;
– des caractéristiques de l'antenne (telles que le type, l'orientation, le gain, etc.);
– de la distance et de l'orientation de l'antenne mobile par rapport au câble;
– de la nature de l'atmosphère ambiante;
– de la gamme de fréquences opérationnelles;
– de la manière d'installer le câble;
– de la forme, du matériau et de la taille des bâtiments environnants.