IEC 61196-1-124

Edition 1.0 2022-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Câbles coaxiaux de communication –
Partie 1-124: Méthodes d'essai électrique – Essai de perte de couplage des câbles rayonnants

IEC 61196-1-124:2022-08(en-fr)

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COAXIAL COMMUNICATION CABLES –

**Part 1-124: Electrical test methods –
Test for coupling loss of radiating cable**

FOREWORD

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IEC 61196-1-124 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.

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

Draft	Report on voting
46A/1578/FDIS	46A/1587/RVD

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

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

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

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

COAXIAL COMMUNICATION CABLES –

Part 1-124: Electrical test methods – Test for coupling loss of radiating cable

1 Scope

This part of IEC 61196 defines the test method to determine the coupling loss of radiating coaxial communication cables that are intended for use in wireless communication systems such as tunnels, railways, highways, subways, elevators and other confined areas in which conventional antenna transmission is not satisfactory or even impossible.

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

IEC 61196-4, *Coaxial communication cables − Part 4: Sectional specification for radiating cables*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61196-1 and IEC 61196-4 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

4 Methodology

4.1 General

The measurements of coupling loss for radiating cables can be carried out by one of the two methods, where the free-space method shall be the arbitration method if there is an argument:

– free-space method;

– ground-level method.

4.2 Free-space method

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

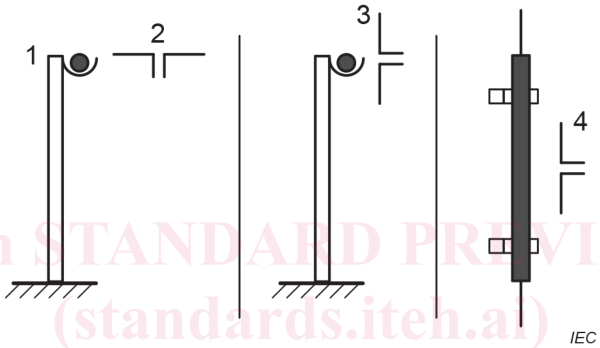
The cable shall be at least 10 λ, where λ is the cable wavelength of the measuring frequency, but not shorter than 50 m or 10 λ; the larger value is applicable.

The antenna is put on a trolley and moved parallel to the cable. The height of the antenna centre should be the same as that of the cable and its horizontal distance from the cable should be about 2 m (additional distance can be added in the detail specification). Preferably, a half-wavelength dipole shall be used. Type and gain of antenna used should be stated in the test report.

No other metallic parts than the cable and the antenna should 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 should be as specified in the detail specification.

For basic antenna orientations for a dipole, see Figure 1.



Key

1 cable

2 radial

3 orthogonal

4 parallel

Figure 1 – Antenna orientations with free-space method

4.3 Ground-level method

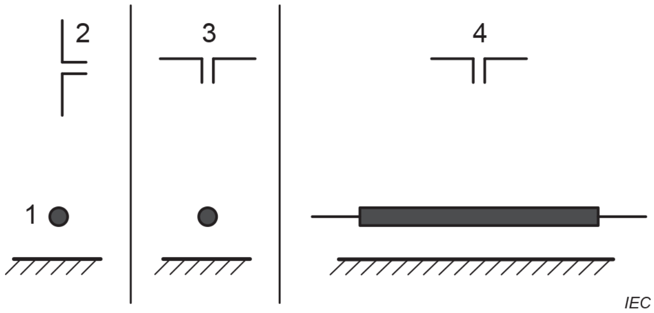
The arrangement of the cable is given in Figure 2. The cable is laid on non-metallic spacers which gives the cable a distance from the concrete floor of 10 cm to 12 cm.

The cable shall be at least 10 λ, where λ is the cable wavelength of the measuring frequency, but not shorter than 50 m or 10 λ; the larger value is applicable.

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 (additional distance may be added in the detail specification). Preferably, a half-wavelength dipole shall be used. Type and gain of antenna used should be stated in the test report.

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

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



Key

1 cable

2 radial

3 orthogonal

4 parallel

Figure 2 – Antenna orientations with ground-level method

5 Test procedures

5.1 General

The 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)) can be defined by the following formula:

$$L_c = 10 \cdot \log\left(\frac{P_t}{P_r}\right) \tag{1}$$

where

L_c is the coupling loss, expressed in dB;

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

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

5.2 Equipment

The following equipment can be used:

– a signal generator;

– a spectrum analyser (receiver);

– a vector network analyser.

5.3 Calibration

Connect the signal generator directly to the spectrum analyser with a short reach test lead. The difference of power level between the signal generator and the spectrum analyser at every specific frequency should be recorded as N_e prior to the measurement.

5.4 Measurement

Adjust the signal 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.

The test setup for free-space and ground-level method are given as Figure 3 and Figure 4, respectively.

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 measurements shall not be less than 1 000.

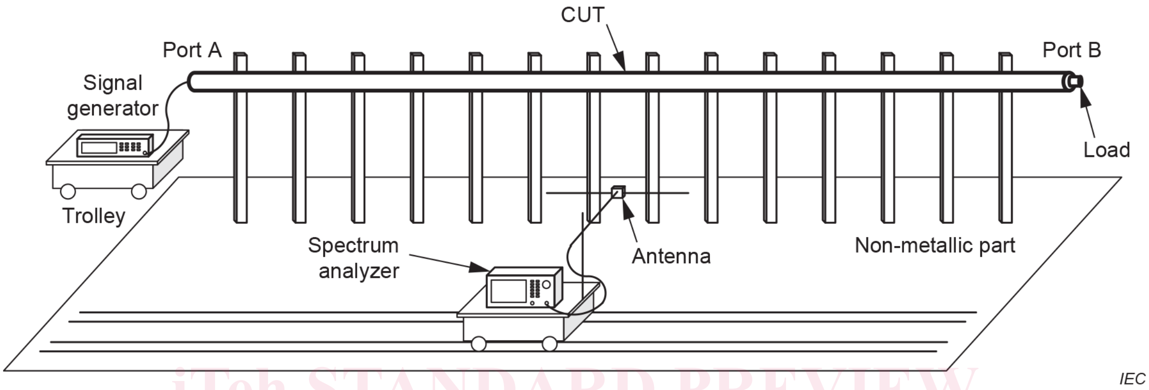


Figure 3 – Coupling loss with free-space method

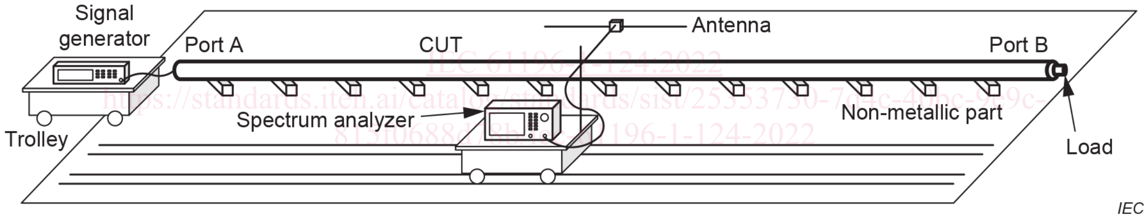


Figure 4 – Coupling loss with ground-level method

6 Expression of test results

6.1 Expression

The coupling loss can be computed as:

$$L_c(z) = N_e - N_r(z) - (\alpha \cdot z) + G \qquad (2)$$

where

G is the gain of the antenna, expressed in dBd;

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

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

N_r is the power level at the antenna, expressed in dBm;

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

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

NOTE The test for attenuation constant of radiating cable is specified in IEC 61196-1-123.

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 shall 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.

6.2 Mean value of the 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:

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

where

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

7 Test report

Test report shall give the following information:

– test sample length;
– test method;
– antenna type;
– antenna gain;
– antenna orientation;
– distance between antenna and radiating cable (if not 2 m).

8 Requirements

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