

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Waveguide to coaxial adapters –
Part 1: Generic specification – General requirements and test methods**

**Adaptateurs coaxiaux pour guide d'ondes –
Partie 1: Spécification générique – Exigences générales et méthodes d'essai**

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WAVEGUIDE TO COAXIAL ADAPTERS –**Part 1: Generic specification –
General requirements and test methods**

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IEC 63249-1 has been prepared by subcommittee 46F: RF and microwave passive components, 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
46F/511/CDV	46F/549/RVC

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

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

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available

at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts of the IEC 63249 series, under the general title *Waveguide to coaxial adapters* can be found on the IEC website.

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

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WAVEGUIDE TO COAXIAL ADAPTERS –

Part 1: Generic specification – General requirements and test methods

1 Scope

This part of IEC 63249 defines general requirements and test methods for waveguide to coaxial adapters. It includes terms and definitions, design and construction, ratings and characteristics, climatic categories, IEC type designation, requirements and test methods, quality assessment, marking, etc.

It provides the basis for establishing the sectional specifications for various waveguide to coaxial adapters.

This specification applies to waveguide to coaxial adapters (short name adapter).

For the purpose of this specification, according to ends, adapters are classified as the following:

- Class I: Waveguide to coaxial connector adapter, waveguide at one end and coaxial connector at the other end;
- Class II: Waveguide to coaxial cable adapter, waveguide at one end, and coaxial cable at the other end;
- Class III: Waveguide to coaxial cabled connector adapter, waveguide at one end, and coaxial cabled connector at the other end.

According to whether the inner conductor probe of coaxial end is connected with the inner wall of waveguide cavity or not, adapters are classified as the following :

- Connected adapter: Inner conductor probe of coaxial end is connected with inner wall of waveguide cavity;
- Disconnected adapter: Inner conductor probe of coaxial end is disconnected with inner wall of waveguide cavity.

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 60050-726, *International Electrotechnical Vocabulary (IEV) – Part 726: Transmission lines and waveguides*

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-11, *Environmental testing – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

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

IEC 60153 (all parts), *Hollow metallic waveguides*

IEC 60154 (all parts), *Flanges for waveguides*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60617, *Graphical symbols for diagrams* (available from: <http://std.iec.ch/iec60617>)

IEC 61169 (all parts), *Radio frequency connectors*

IEC 61169-1, *Radio frequency connectors – Part 1: Generic specification – General requirements and measuring methods*

IEC 61196 (all parts), *Coaxial communication cables*

IEC 61726, *Cable assemblies, cables, connectors and passive microwave components – Screening attenuation measurement by the reverberation chamber method*

3 Terms and definitions

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4 Design and construction

4.1 General

The adapters shall be designed and constructed to ensure such features as adequate accuracy, long mechanical endurance, and good repeatability. The relevant specification is not intended to restrict those designs and dimensions for details of construction which do not influence interchange ability or performance, nor are they to be used as manufacturing drawings.

The coaxial extension of each adapter shall be positioned on the waveguide so that all the electrical requirements are satisfied. No constructional detail of the adapters shall influence mating of the waveguide, flange and coaxial end with their counterparts.

All of mechanical drawings shall be made as specified in IEC 60617. The dimensions and tolerances shall be given in metric units. During conversion of dimensions given in inches into millimeters, they shall be rounded to the nearest 0,001 mm or 0,000 05 in. However, when mechanical and electrical conditions permit, they shall be rounded to the nearest 0,01 mm or 0,000 5 in.

4.2 Material and finishes

The materials and finishes used for the adapters shall be as specified in the safety and environmental regulations and in relevant specifications. Dissimilar metals between which an electromotive couple may exist, shall not be placed in contact with each other.

4.3 Construction dimensions

Adapters shall be of the construction dimensions as stated in the relevant specification.

a) waveguide and flange

The waveguides shall be as specified in relevant specifications of IEC 60153 and the flanges shall be as specified in relevant specifications of IEC 60154 or the relevant specification of waveguide to coaxial adapter. The perpendicularity of waveguide flange to waveguide tube axis should be $90^\circ \pm 0,25^\circ$.

b) coaxial connector

The coaxial connectors shall be as specified in relevant specifications of IEC 61169 or relevant specifications of waveguide to coaxial adapter. The critical relative position dimensions for the interface shall be as stated in the relevant specification.

c) coaxial cable

The coaxial cables shall be as specified in relevant specifications of IEC 61196 or relevant specifications of waveguide to coaxial adapter.

4.4 Protection of ends

The ends of adapters shall be protected with caps, covers or other appropriate means to prevent damage and entrance of moisture and foreign material.

5 Standards ratings and characteristics

The ratings and characteristics applicable to adapters should be specified in the relevant specification. If possible, the following ratings or characteristics shall be included:

- a) the working voltage at different altitudes (if applicable);
- b) frequency range;
- c) the climatic categories;
- d) any other ratings or characteristics applicable.

6 Climatic categories

The classification of adapters with regard to climatic conditions is based on IEC 60068-1 and indicated by a series of three sets of digits separated by oblique strokes corresponding respectively to tests at low temperature (minus sign not shown), high temperature and the number of days of exposure to damp heat, steady state.

The climatic severities are referenced by a cold temperature, high temperature and damp heat steady state duration. Examples of climatic category of this are shown in Table 1:

Table 1 –Preferred climatic categories (see IEC 60068-1)

Category designation	Letter	Temperature range	Damp heat, steady state
40/85/21	A	–40 °C to +85 °C	21 days
55/125/21	B	–55 °C to +125 °C	21 days
55/155/56	C	–55 °C to +155 °C	56 days

7 IEC type designation

The purpose of the IEC type designation is to identify a particular adapter within the scope of IEC waveguide to coaxial adapter standardization. It is not intended to include information in excess of this.

In practice, it is usually necessary to identify a manufacturer's product because, although complying with this document, there may be features that are not covered by this document.

The adapters complying with the relevant specifications shall be designated by the following indications and in the order given:

- a) the number of this document;
- b) the letters "IEC";
- c) the code number of each end of adapters, individually, as follows:
 - Class I: Waveguide type /connector type;
 - Class II: Waveguide type/cable type;
 - Class III: Waveguide type/connector type - cable type.
- d) additional identification as specified in the relevant specification.

NOTE When an IEC type designation is used, either for the marking of the product or in a description of the product, it is the responsibility of the manufacturer to ensure that the item meets the requirements of the relevant specification.

8 Requirements and test methods

8.1 General

Unless otherwise specified, the following conditions shall apply.

- a) tests shall be carried out under standard atmospheric conditions for testing as specified in IEC 60068-1;
- b) before measurements are made, the adapters shall be preconditioned under standard atmospheric conditions for testing for a time sufficient to allow the entire adapter to reach thermal stability;
- c) recovery conditions for the interval after a conditioning and the next measurement of test shall be in accordance with IEC 60068-1.

When a nominal value only is given for an applied stress and/or the duration of application, the specified value shall be taken to indicate the minimum test severity to be applied.

The test shall be carried out on the adapters as received from the supplier.

Nominal coupling torque value shall be specified for screw-coupled connectors at coaxial ends of adapters in the relevant specification.

8.2 Visual inspection

8.2.1 Requirements

Visual inspection shall meet the following requirements:

- a) marking
 - It shall be correct in accordance with 10.1 and be legible after any of the specified tests.
- b) Workmanship

Adapters and associated fittings shall be processed in such a manner as to be uniform in quality and shall be free from visible sharp edges, burrs and other defects that will affect life, serviceability or appearance.

c) deterioration after electrical, mechanical and environmental tests

Unless otherwise specified, there shall be no visible deterioration likely to influence the performance.

d) marking of package

It shall be in accordance with 10.1.

8.2.2 Inspection procedure

The inspection will be performed visually or by a magnifier under a magnification as stated in the relevant specification.

8.3 Dimensions

8.3.1 Dimensions of waveguide and flange

8.3.1.1 Requirements

The dimensions of waveguide and flange shall be in accordance with the relevant specifications.

8.3.1.2 Inspection procedure

The inspection for dimensions of waveguide and flange shall be performed using measuring tool or gauge with adequate accuracy.

8.3.2 Interface dimensions of connector

8.3.2.1 Requirements

The dimensions of connector shall be in accordance with the mating face drawings, stated in the relevant specification.

8.3.2.2 Inspection procedure

The inspection for the interface dimensions of connectors shall be performed by mating the gauge stated in the relevant specification with the connector.

8.3.3 Dimensions of cable

8.3.3.1 Requirements

The dimensions of cable shall be as stated in the relevant specification.

8.3.3.2 Inspection procedure

The inspection for the dimensions of cable shall be performed by using measuring tool with adequate accuracy.

8.3.4 Outline dimensions

8.3.4.1 Requirements

The outline dimensions shall be as specified in the relevant specification.

8.3.4.2 Inspection procedure

The inspection for the outline dimensions shall be performed using measuring tool with adequate accuracy.

8.4 Electrical tests

8.4.1 Voltage proof (applicable for disconnected adapter)

8.4.1.1 Requirements

The coaxial end of the adapter shall withstand the voltage specified in the relevant specification without breakdown or flashover.

8.4.1.2 Test procedure

A test voltage specified in the relevant specification is applied between inner and outer conductors of the coaxial end of the adapter, and the high voltage side of the test system is connected to the inner conductor.

It shall be applied for 60s, unless otherwise prescribed in the relevant specification.

8.4.1.3 Information to be given in the relevant specification

The following information shall be reported in the relevant specification:

- a) value of the test voltage;
- b) maximum leakage current;
- c) any deviation from the standard test method.

8.4.2 Insulation resistance (applicable for disconnected adapter)

8.4.2.1 Requirements

The insulation resistance for the coaxial end of the adapter shall be not less than the value specified in the relevant specification.

8.4.2.2 Test procedure

The insulation resistance shall be measured between inner and outer conductors of the coaxial end.

The test equipment shall have a suitable range to cover the resistance being measured.

The test voltage should be a DC voltage of $500\text{ V} \pm 50\text{ V}$ or the rated voltage of the adapter, whichever is less. The insulation resistance shall be measured in 2 min.

8.4.2.3 Information to be given in the relevant specification

The following information shall be reported in the relevant specification:

- a) value of the test voltage if other than 500 V;
- b) minimum value of insulation resistance;
- c) any deviation from the standard test method.

8.4.3 Voltage standing wave ratio (VSWR)

8.4.3.1 Requirements

Voltage standing wave ratio shall not exceed the value specified in the relevant specification.

8.4.3.2 Test procedure

Using the waveguide end and the coaxial end as the input end respectively, the VSWR shall be measured over the specified frequency range. For class II adapters, the coaxial end should be terminated with a appropriate connector.

The test procedure is as follows:

- a) after the vector network analyser (VNA) is fully preheated, set measurement frequency range, and then set the test mode as S_{11} ;
- b) system calibration: Use the open, short, load separately to calibrate VNA;
- c) standard test adaptor calibration (when needed): When the test cable port of VNA cannot directly connect with the test specimen (DUT), the standard test adaptors need to be used;
- d) connect the DUT between VNA and the load or the two adapters, and record the S_{11} graph;
- e) turn DUT around, test the DUT in the other direction and record S_{11} graph.

8.4.3.3 Information to be given in the relevant specification

The following information shall be reported in the relevant specification:

- a) frequency range;
- b) maximum value of VSWR;
- c) details (or drawing) of the adaptor or load to be mated with the DUT, when needed;
- d) any deviation from the standard test method.

8.4.4 Insertion loss

8.4.4.1 Requirements

Insertion loss shall be not greater than the value specified in the relevant specification.

8.4.4.2 Test procedure

Using the waveguide end and the coaxial end as the input end respectively, the insertion loss shall be measured over the specified frequency range. For class II adapters, the coaxial end should be terminated with a appropriate connector.

The insertion loss of adapters should be measured as follows:

- a) after VNA is fully preheated, set measurement frequency range, and set test mode as S_{12} or S_{21} ;
- b) system calibration: The two test cable ports of the VNA shall be connected and calibrated;
- c) connect the DUT to VNA, and record the S_{12} or S_{21} graph. If the two test ports of VNA cannot be connected directly to the DUT, standard test adaptors are needed.

8.4.4.3 Information to be given in the relevant specification

The following information shall be reported in the relevant specification:

- a) frequency range;
- b) limit value of insertion loss;

- c) details (or drawing) of the adaptor to be mated with the DUT, when needed;
- d) cable type to be specified for waveguide to coaxial cabled connector adapter;
- e) any deviation from the standard test method.

8.4.5 RF power handling (if applicable)

8.4.5.1 Requirements

Adapters shall withstand power indicated in the relevant specification at the specified frequency, temperature, and equivalent altitude without breakdown. The VSWR and insertion loss after test shall be as stated in the relevant specification.

8.4.5.2 Test procedure

The test procedure is as follows:

- a) put the adapter into the test chamber, and connect the adapter under test to the test system;
- b) the temperature and equivalent altitude in the chamber shall be in accordance with the relevant specification;
- c) set the frequency parameters, apply a small power signal to the test circuit, and check the continuity of the test circuit;
- d) apply the power value stated in the relevant specification to DUT for a period specified in the relevant specification;
- e) after test, measure VSWR and insertion loss of the DUT.

8.4.5.3 Information to be given in the relevant specification

The following information shall be reported in the relevant specification:

- a) measurement frequency and power value;
- b) temperature and equivalent altitude (if necessary);
- c) VSWR and insertion loss;
- d) details (or drawing) of the adaptor to be to be mated with the DUT;
- e) any deviation from the standard test method.

8.4.6 Screening effectiveness (if applicable)

8.4.6.1 Requirements

It shall be as specified in the relevant specification.

8.4.6.2 Test procedure

The adapter shall be tested for screening effectiveness as specified in IEC 61726.

8.4.6.3 Information to be given in the relevant specification

The following information shall be reported in the relevant specification:

- a) frequency range;
- b) value of screening effectiveness;
- c) details (or drawing) of the adaptor to be to be mated with the DUT;
- d) any deviation from the standard test method.