IEC 60153-2

Edition 3.0 2016-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Hollow metallic waveguides –
Part 2: Relevant specifications for ordinary rectangular waveguides

Guides d'ondes métalliques creux –
Partie 2: Spécifications applicables relatives aux guides d'ondes rectangulaires normaux

IEC 60153-2:2016-05(en-fr)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.120.10

ISBN 978-2-8322-3383-2

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HOLLOW METALLIC WAVEGUIDES –

Part 2: Relevant specifications for ordinary rectangular waveguides

FOREWORD

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International Standard IEC 60153-2 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.

This third edition cancels and replaces the second edition published in 1974. This edition constitutes a technical revision.

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

a) expand and revise the operation frequency range for waveguides;

b) revise the allowance of aperture dimensions;

c) revise the test method for aperture dimensions;

d) revise the equation of attenuation.

The text of this standard is based on the following documents:

CDV	Report on voting
46F/303/CDV	46F/317/RVC

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60153 series, published under the general title *Hollow metallic waveguides*, can be found on the IEC website.

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

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- withdrawn,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

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INTRODUCTION

This International Standard relates to straight hollow metallic tubing for use as waveguides in electronic equipment. In recent year the operation frequency of waveguide components and system has been extended to 1 THz and above. However, the first edition of the IEC 60153 series of standards only specified the aperture dimensions for ordinary rectangular waveguide for frequencies up to 325 GHz. In addition, the first edition of the IEC 60153 series of standards, dating from the 1960's, does not cover current applications. This new edition of IEC 60153-2 addresses these two issues by extending the frequency coverage to 3 300 GHz and by addressing current applications for this type of waveguide.

HOLLOW METALLIC WAVEGUIDES –

Part 2: Relevant specifications for ordinary rectangular waveguides

1 Scope

This part of IEC 60153 specifies straight hollow metallic tubing of ordinary rectangular waveguide for use as waveguides in electronic equipment.

The aim of this standard is to specify for hollow metallic waveguides:

a) the details necessary to ensure compatibility and, as far as essential, interchangeability;

b) test methods;

c) uniform requirements for the electrical and mechanical properties.

It should be noted that no recommendations are made for the materials to be used for waveguides. The choice of material is agreed between customer and manufacturer.

This document should be read in conjunction with IEC 60153-1, which gives general requirements and test methods.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org/>)

IEC 60153-1:2016, *Hollow metallic waveguides – General requirements and measuring methods*

IEC 60261, *Sealing test for pressurized waveguide tubing and assemblies*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-726 apply.

4 General

4.1 Standardized types

The series of ordinary rectangular waveguides covered by this publication are shown in Table 1.

4.2 Type designation

For these waveguides, the type designation comprises:

a) the code: 60153 IEC-R

b) a number characterizing a particular size of waveguide. This number expresses approximately in multiples of 100 MHz the geometric mean frequency of the recommended frequency range;

c) if the symbol “K” is being used to indicate a factor of 1 000 (which it is suspected that it is), then the symbol needs to be in lower case (i.e. “k”), which stands for “kilo” in the SI system. This affects many waveguide names given in Table 3 and elsewhere in this standard.

Example:

"60153 IEC-R 100" denotes a 22,860 mm × 10,160 mm (0,900 in × 0,400 in) ordinary rectangular waveguide for general purposes with a centre frequency of approximately 10 GHz in the dominant mode.

4.3 Frequency range

The frequency range indicated in Table 1 is from approximately 1,25 to 1,9 times the cut-off frequency in the dominant mode. For any particular type of application, the working frequency range may be smaller or greater than the frequency range given in the table.

5 Mechanical requirements

5.1 General

It should be noted that no recommendations are made for the materials to be used for waveguides. The choice of material shall be agreed upon between customer and manufacturer.

5.2 Dimensions

5.2.1 General

The series of ordinary rectangular waveguides covered by this publication are shown in Table 1.

5.2.2 Inside dimensions

The nominal values for the waveguide aperture height and width, and the permissible maximum deviations in these nominal values, are specified in Table 3.

The deviations for both the width and height of the waveguide aperture are summarized in Table 1.

Table 1 – Deviation of aperture dimension

Range of sizes	Deviation ± (%) of *a*
R 3 – R 500	0,2
R 620 – R 4K	0,5
R 5K – R 14K	1,0
R 18K – R 36K	2,0

Although some difficulty has been experienced in manufacturing waveguides that meet these deviation requirements, in practice, small departures from these deviations create no serious electrical discontinuity problems, except at the terminations of the waveguide.

To accomplish satisfactory electrical mating, it is generally necessary to use a tool for sizing the waveguide opening after the flange has been mounted.

When accurately sized lengths of waveguides are required for critical component fabrication, it is industrial practice to pass a sizing mandrel through the entire length of short waveguide sections.

5.2.3 Wall thickness

The basic values specified in Table 3 conform to the following rules:

The basic wall thickness is defined as half the difference between the basic outside and inside dimensions in the original systems of units.

After conversion from inches into mm, the values were rounded to the nearest 0,005 mm.

5.2.4 Eccentricity

The eccentricity is defined as half the difference between the measured thickness of opposite walls. Unless otherwise specified, the eccentricity shall not exceed 10 % of the basic wall thickness. For the determination of the eccentricity, the thickness shall be measured where they give the most unfavourable result.

5.2.5 Outside dimensions

The basic values and the deviations are specified in Table 2.

The values of the outside dimensions deviations are also given in Table 2.

Table 2 – Deviation of outside dimensions

Range of sizes	Deviation ±
R12 and larger dimensions	For future study
R 14 – R 70	0,10 % of inside basic width
R 84 – R 900	0,05 mm
R 1.2K – R 2.6K	0,025 mm
R 3.2K – R 36K	If necessary

No outside dimensions have been specified for some of the largest sizes because a variety of manufacturing techniques are used.

The outside corner radius (r_2) shall be within the following limits:

r_{2min} = 0,5 t

r_{2max} = r_{2min} + 0,5 mm

where t is the basic wall thickness.

5.2.6 Rectangularity of cross-section

The dimensional requirements in 5.2.2 and 5.2.5 do not control the rectangularity of the cross-section.

The allowed departure from rectangularity is defined by the requirement that the shape of the inside (outside) cross-section shall be such that it is possible to inscribe the actual internal (external) cross-section in the area between the specified maximum and minimum internal (external) rectangles. A suitable method for checking rectangularity is given below by way of example.

a) For inside cross-section

A block with the dimensions specified below shall pass through the waveguide without hindrance.

In drawing the block through the waveguide, precaution shall be taken to keep it accurately normal to the waveguide axis.

For the dimensions of the block, the following applies:

- basic dimensions of cross-section: basic waveguide aperture size minus 1,1 section times the deviation;
- deviation on basic inside cross-section dimensions: +0, –0,1 times deviation on waveguide of cross-section aperture;
- perpendicularity of the sides: within 3×10^{-4} radians;
- length: 0,2 times internal width of the waveguide.

b) For outside cross-section

The outside cross-section shall be such that it is possible to pass the waveguide through a standard gauge with an aperture of rectangular cross-section as specified below.

For the dimensions of the aperture, the following applies:

- basic dimensions of cross-section: basic waveguide outside cross-section plus 1,1 times the deviation;
- deviation on basic dimensions of cross-section: –0, + 0,1 times deviation on waveguide outside cross-section;
- perpendicularity of the sides: not deviating by more than 3×10^{-4} radians.

5.3 Other mechanical requirements

5.3.1 Bow

Bow is defined as the maximum departure of the actual axis of the waveguide from a straight line of specified length connecting two points on that axis.

The bow is measured on the external surface of the waveguide. For a length of 10 times the internal width, the external bow shall not exceed 10 times the specified deviation on the internal width.

For a length of 50 times the internal width, the external bow shall not exceed 40 times the specified deviation on the internal width.

For the determination of the external bow, the waveguide shall be so positioned that gravity does not tend to affect the amount of bow.