IEC 61196-1-215

Edition 1.0 2016-03

INTERNATIONAL STANDARD

Coaxial communication cables –
Part 1-215: Environmental test methods – High temperature cable ageing

IEC 61196-1-215:2016-03(en)

International Electrotechnical Commission

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

IEC 61196-1-215

Edition 1.0 2016-03

INTERNATIONAL STANDARD

Coaxial communication cables –
Part 1-215: Environmental test methods – High temperature cable ageing

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.120.10

ISBN 978-2-8322-3251-4

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

COAXIAL COMMUNICATION CABLES –

Part 1-215: Environmental test methods – High temperature cable ageing

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61196-1-215 has been prepared by subcommittee 46A: Coaxial cables, of IEC technical committee 46: Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories.

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

FDIS	Report on voting
46A/1297/FDIS	46A/1300/RVD

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

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

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC 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.

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

COAXIAL COMMUNICATION CABLES –

Part 1-215: Environmental test methods – High temperature cable ageing

1 Scope

This part of IEC 61196 defines a thermal ageing test to evaluate the transmission performance of coaxial cables under the effects of material temperature ageing.

This procedure specifies a qualitative thermal ageing test that evaluates the performance degradation of the cable due to chemical and physical reactions that are accelerated by high temperature.

Information on acceleration life testing is provided in Annex A.

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 www.electropedia.org)

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

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050 and IEC 61196-1 apply.

4 Method

4.1 General

The allowable RF transmission performance characteristics and mechanical pass and fail criteria shall be specified in the detail specification.

RF performance shall consider the allowable change in the following characteristics:

a) insertion loss,

b) return loss, and/or

c) passive intermodulation, RF-leakage, time delay or impedance.

Mechanical movement shall consider:

1) movement of conductors,
2) diameter over sheath change.

4.2 Test samples

The cable length shall be sufficient to perform the following measurements and shall be specified in the detail specification.

A minimum of two samples should be used for the test as specified below.

a) For the transmission performance characteristics, a cable with connectors attached.
b) For the mechanical movement of the conductors or materials used in the cable, a cable with its ends cut flushed.

A minimum of one sample of each type shall be used for this test.

If the sample is coiled to fit into the chamber, it should be loosely coiled at the minimum bend radius with the end of the cable being straight.

4.3 Test chamber

The test chamber shall be in accordance with IEC 60068-2-2 at the maximum operational temperature rating of the cable under test.

4.4 Test procedure

4.4.1 Initial measurements

The RF transmission performance and specified mechanical measurements on each sample shall be made.

4.4.2 Sample ageing

The samples shall be placed in the test chamber at the specified test temperature.

The test duration shall be a minimum of 2 000 h, unless otherwise specified.

4.4.3 Final measurements

After the test, the units shall be removed from the chamber and allowed to stabilize at room ambient temperature.

After reaching room ambient temperature, the RF transmission performance and specified mechanical measurements shall be repeated.

4.5 Criteria

The mechanical test shall monitor the relative movement of the dielectric, sheath, and conductors. The criteria for acceptance shall be described in the detailed specification.

The RF transmission performance shall be measured prior to the test and at the end of the test, and the change in performance shall be calculated. The criteria for acceptance shall be specified in the detailed specification.

5 Test report

The test report shall include

a) description of the tested cable and length
b) description of the type of connector used
c) test conditions
    1) test temperature,
    2) duration,
    3) length of cable,
    4) number of samples,
    5) diameter of coil,
d) the results measured and whether or not the results are satisfactory
    1) RF transmission performance deviation results,
    2) mechanical deviation results,
e) criteria for acceptable performance.

Annex A
(informative)

Background information and predictive measurements

The purpose of Annex A is to provide background information on the application of acceleration testing due to heat ageing and provide a method to make predictive measurements to predict the equivalent time at a different temperature.

High temperature ageing assumes that degradation is occurring due to a chemical reaction which is accelerated by the temperature. The intent is to test the product at as high as a possible temperature to accelerate the failure mechanism, rather than cause one. To do this, there needs to be a design margin over the product rating. This reaction rate for chemical reactions is described by the Arrhenius formula as follows:

$$R(T) = A \cdot e^{-\frac{E_a}{K_B \cdot T}} \tag{1}$$

where

A is the constant (not a function of temperature);

E_a is the activation energy (eV);

K_B is the Boltzman's constant = 8,617385 x 10^{-5} eV/K;

T is the absolute temperature (K);

$R(T)$ is the reaction rate as a function of the absolute temperature.

E_a or A constants may be obtained from reference books or they may be obtained through experiments.

The acceleration factor (AF) between temperatures T_1 and T_2 is given by the following:

$$AF = \frac{R(T_2)}{R(T_1)} = \frac{A \cdot e^{-\frac{Ea}{K_B \cdot T_2}}}{A \cdot e^{-\frac{Ea}{K_B \cdot T_1}}} = e^{\frac{Ea}{K_B} \cdot \left(\frac{1}{T_1} - \frac{1}{T_2}\right)} \tag{2}$$

Equation (2) provides a means to calculate the acceleration factor due to different temperatures which can be used to predict the test hours from the test time at a temperature to the operational time at another temperature.

Examples

The following examples will provide examples of the effect of how the acceleration factor is influenced by the test temperature and operating temperature. Additional information can be obtained in IEC 62506.

For an acceleration factor of 10, it means 1 h of test is equal to 10 h of use.

The operational temperature is the temperature the product reaches in actual use and not the operational ambient temperature. In practice the operational temperature is not constant and

varies. Therefore, the model may be adjusted for percentages of times at various operational temperatures.

The maximum test temperature may be limited to temperature limitations of the materials in the cable construction that when exceeded cause the destruction of the cable rather than accelerating the failure mechanism. For example, exceeding the temperature rating of the foam material may cause melting which would void the test. In many cases, the temperature rating of the material may not be a test limit, but a rating to provide suitable reliability over its useful life.

a) Example 1:

   An ageing test is planned to be run at 150 °C (T_2) for 2 000 h. If the product is operating at 80 °C (T_1), the equivalent time at 80 °C is calculated as follows:

   Assume: E_a = 0,7

   Substitute the numbers into equation (2). The AF (equation (2)) is calculated to be 44,9.

b) Example 2:

   Example 1 is repeated except that the test temperature is reduced to 110 °C.

   The acceleration factor reduces to 6,1.

c) Example 3:

   Example 2 is repeated with a lower operational temperature of 60 °C.

   The acceleration factor becomes 24,1.

Bibliography

IEC 62506, *Methods for product accelerated testing*

_____

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch