

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Directly heated negative temperature coefficient thermistors –
Part 2: Sectional specification – Surface mount negative temperature coefficient
thermistors**

**Thermistances à coefficient de température négatif à chauffage direct –
Partie 2: Spécification intermédiaire – Thermistances à coefficient de
température négatif pour montage en surface**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2019 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

Tel.: +41 22 919 02 11
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 corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

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 It also gives information on projects, replaced and withdrawn publications.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 once a month by email.

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: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22,000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67,000 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.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Directly heated negative temperature coefficient thermistors –
Part 2: Sectional specification – Surface mount negative temperature coefficient
thermistors**

**Thermistances à coefficient de température négatif à chauffage direct –
Partie 2: Spécification intermédiaire – Thermistances à coefficient de
température négatif pour montage en surface**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.040.30

ISBN 978-2-8322-7098-1

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references	6
3 Terms and definitions	6
4 Information to be given in a detail specification.....	7
4.1 General.....	7
4.2 Outline drawing and dimensions	7
4.3 Mounting.....	7
4.4 Ratings and characteristics	7
4.4.1 Particular characteristics	7
4.4.2 Marking	7
5 Preferred ratings and characteristics	7
5.1 Tolerances on rated zero-power resistance.....	7
5.2 Climatic categories	8
6 Quality assessment procedures	8
7 Test and measurement procedures.....	8
7.1 Mounting.....	8
7.2 Drying and recovery.....	8
7.2.1 Drying.....	8
7.2.2 Recovery	8
7.3 Visual examination and check of dimensions	8
7.3.1 Visual examination.....	8
7.3.2 Requirements	9
7.3.3 Marking	10
7.3.4 Dimensions.....	11
7.4 Electrical tests	11
7.4.1 Zero-power resistance	11
7.4.2 <i>B</i> -value or resistance ratio	11
7.4.3 Resistance/temperature characteristic	11
7.5 Thermal tests.....	12
7.5.1 Dissipation factor (δ).....	12
7.5.2 Thermal time constant by cooling after self-heating (τ_c).....	12
7.6 Resistance to soldering heat.....	12
7.6.1 General	12
7.6.2 Initial measurement	12
7.6.3 Test conditions	12
7.6.4 Recovery	12
7.6.5 Final inspection, measurements and requirements.....	12
7.7 Solderability.....	13
7.7.1 General	13
7.7.2 Test conditions	13
7.7.3 Recovery	13
7.7.4 Final inspection, measurements and requirements.....	13
7.8 Rapid change of temperature.....	13
7.9 Thermal shock	13

7.10	Damp heat, steady state	14
7.11	Endurance	14
7.11.1	Endurance at T_3 and P_{max}	14
7.11.2	Endurance at upper category temperature	15
7.12	Shear (adhesion) test.....	15
7.13	Substrate bending test	15
7.14	Component solvent resistance	15
7.15	Solvent resistance of marking	15
Annex A (normative) Guide for the specification and coding of dimensions of surface mount negative temperature coefficient thermistors		16
Annex B (normative) Quality assessment procedure		17
B.1	Primary stage of manufacture	17
B.2	Structurally similar components	17
B.3	Qualification approval procedures	17
B.4	Quality conformance inspection	17
B.4.1	General	17
B.4.2	Qualification approval on the basis of the fixed sample size procedure	17
B.5	Quality conformance inspection	19
B.5.1	Formation of inspection lots	19
B.5.2	Test schedule	20
B.5.3	Delayed delivery	20
B.5.4	Assessment level	20
<p style="color: red; font-weight: bold; font-size: 1.2em;">iTech STANDARD PREVIEW</p> <p style="color: red; font-weight: bold; font-size: 1.2em;">(standards.iteh.ai)</p>		
Figure 1	– Fault: fissure or defect	9
Figure 2	– Fault: crack	9
Figure 3	– Separation or delamination	9
Figure 4	– Exposed electrodes.....	10
Figure 5	– Principal faces	10
Figure 6	– Principal terminations – Gull wing	11
Figure 7	– Principal terminations – Round termination	11
Figure A.1	– Dimensioning of surface mount thermistors.....	16
Table 1	– Upper and lower category temperatures and duration of the damp heat test.....	8
Table A.1	– Dimensions	16
Table B.1	– Fixed sample size test schedule for qualification approval of surface mount negative temperature coefficient thermistors Assessment level EZ	19
Table B.2	– Lot-by-lot inspection.....	20
Table B.3	– Periodic test.....	21

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**DIRECTLY HEATED NEGATIVE TEMPERATURE
COEFFICIENT THERMISTORS –****Part 2: Sectional specification –
Surface mount negative temperature coefficient thermistors**

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 60539-2 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This second edition cancels and replaces the first edition published in 2003 and Amendment 1:2010. This edition constitutes a technical revision.

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

- a) revision for the structure in accordance with ISO/IEC Directives, Part 2:2016 (seventh edition) to the extent practicable, and for harmonizing with IEC 60539-1:2016;
- b) the upper category temperatures of 175 °C, 200 °C, 250 °C, 315 °C, 400 °C in Table 1 have been added;
- c) the dimensions of 0402M in Annex A have been added.

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

FDIS	Report on voting
40/2672/FDIS	40/2680/RVD

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

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

A list of all parts in the IEC 60539 series, published under the general title *Directly heated negative temperature coefficient thermistors*, 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 "<http://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.

iTeh STANDARD PREVIEW

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

<https://standards.iteh.ai/catalog/standards/sist/bc291106-5b8c-45db-a8ea-7318467f39cc/iec-60539-2-2019>

DIRECTLY HEATED NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS –

Part 2: Sectional specification – Surface mount negative temperature coefficient thermistors

1 Scope

This part of IEC 60539 is applicable to surface mount directly heated negative temperature coefficient thermistors, typically made from transition metal oxide materials with semiconducting properties. These thermistors have metallized connecting pads or soldering strips and are intended to be mounted directly on to substrates for hybrid circuits or on to printed boards.

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 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Tests B: Dry heat*

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*
<https://standards.iteh.ai/catalog/standards/sist/bc291106-5b8c-45db-a8ea-7318467f39cc/iec-60539-2-2019>

IEC 60068-2-58:2015, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60068-2-58:2015/AMD1:2017

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

IEC 60539-1:2016, *Directly heated negative temperature coefficient thermistors – Part 1: Generic specification*

IEC 61193-2:2007, *Quality assessment systems – Part 2: Selection and use of sampling plans for inspection of electronic components and packages*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60539-1 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 Information to be given in a detail specification

4.1 General

Detail specifications shall be derived from the relevant blank detail specification.

Detail specifications shall not specify requirements inferior to those of the generic, sectional or blank detail specification. When more severe requirements are included, they shall be listed in 1.9 of the detail specification and indicated in the test schedules, for example, by an asterisk.

The information given in 4.2 may for convenience, be presented in tabular form.

The information in 4.2 to 4.4 shall be given in each detail specification and the values quoted shall preferably be selected from those given in the appropriate clause of this sectional specification.

4.2 Outline drawing and dimensions

There shall be an illustration of the thermistor as an aid to easy recognition and for comparison with others. Dimensions and their associated tolerances, which affect interchangeability and mounting, shall be given in the detail specification. All dimensions shall preferably be stated in millimetres; however, when the original dimensions are given in inches, the converted metric dimensions in millimetres shall be added.

Normally, the numerical values shall be given for the length, width and height of the body. When necessary, for example when a number of items are covered by a detail specification, the dimensions and their associated tolerances shall be placed in a table below the drawing.

When the configuration is other than described above, the detail specification shall state such dimensional information as will adequately describe the thermistor.

4.3 Mounting

The detail specification shall give guidance on methods of mounting for normal use. Mounting for test and measurement purposes (when required) shall be in accordance with IEC 60539-1:2016, 5.4.

4.4 Ratings and characteristics

4.4.1 Particular characteristics

Additional characteristics may be listed when they are considered necessary to specify the component adequately for design and application purposes.

4.4.2 Marking

See IEC 60539-1:2016, 4.3.

5 Preferred ratings and characteristics

5.1 Tolerances on rated zero-power resistance

Preferred values of tolerances on zero-power resistance are:

$\pm 0,5 \%$, $\pm 1 \%$, $\pm 2 \%$, $\pm 3 \%$, $\pm 5 \%$, $\pm 10 \%$.

5.2 Climatic categories

The upper and lower category temperatures and the duration of the damp-heat steady-state test shall be selected from Table 1.

Table 1 – Upper and lower category temperatures and duration of the damp heat test

Lower category temperature °C	-55, -40, -25, -10, -5, +5
Upper category temperature °C	70, 85, 100, 105, 125, 150, 155, 175, 200, 250, 315, 400
Damp heat, steady state days	21, 42, 56

The detail specification shall prescribe the appropriate category.

6 Quality assessment procedures

See Annex B.

7 Test and measurement procedures

7.1 Mounting

See IEC 60539-1:2016, 5.4.

[IEC 60539-2:2019](https://standards.iteh.ai/catalog/standards/sist/bc291106-5b8c-45db-a8ea-7318467f39cc/iec-60539-2-2019)

[https://standards.iteh.ai/catalog/standards/sist/bc291106-5b8c-45db-a8ea-](https://standards.iteh.ai/catalog/standards/sist/bc291106-5b8c-45db-a8ea-7318467f39cc/iec-60539-2-2019)

7.2 Drying and recovery

[7318467f39cc/iec-60539-2-2019](https://standards.iteh.ai/catalog/standards/sist/bc291106-5b8c-45db-a8ea-7318467f39cc/iec-60539-2-2019)

7.2.1 Drying

Where drying is called for in this specification, the thermistor shall be conditioned as follows.

For $96\text{ h} \pm 4\text{ h}$ in an oven at a temperature of $100\text{ °C} \pm 5\text{ °C}$, the thermistor shall then be allowed to cool in a desiccator using a suitable desiccant, such as activated alumina or silicagel, and shall be kept therein from the time of removal from the oven to the beginning of the specified tests.

7.2.2 Recovery

Unless otherwise specified, recovery shall take place under the standard atmospheric conditions for testing (see IEC 60539-1:2016, 5.3.2).

7.3 Visual examination and check of dimensions

7.3.1 Visual examination

Visual examination shall be carried out with suitable equipment with approximately 10× magnification and lighting appropriate to the specimen under test and the quality level required.

The operator should have facilities available for incident or transmitted illumination as well as an appropriate measuring facility.

7.3.2 Requirements

7.3.2.1 General

Quantitative values for the requirements below may be given in the detail or in the manufacturer's specification.

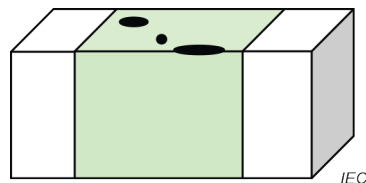
The thermistor shall conform to the following requirements.

7.3.2.2 Requirements for ceramic

Requirements for the ceramic are as follows:

1) Bulk type

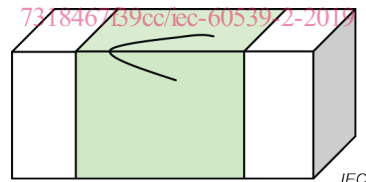
- a) It shall be free of fissures of coating glass longer than 25 % of dimension L_4 (see Annex A, Figure A.1) and defects of glass coating on each face greater than 10 % of the area of that face (see Figure 1).



NOTE Fissure on a corner and defect on one side.

Figure 1 – Fault: fissure or defect

- b) It shall be free of cracks, except for small damage on the surface, which does not impair the performance of the thermistor (see Figure 2).



NOTE Crack on one side or extending from one face to another over a corner.

Figure 2 – Fault: crack

2) Layered type

- a) It shall not exhibit visible separation or delamination between the layers of the thermistor (see Figure 3). Excluding the case when a few things which do not influence a characteristic of the surface implementation form an NTC thermistor, the surface shall not be cracked (see Figure 3).

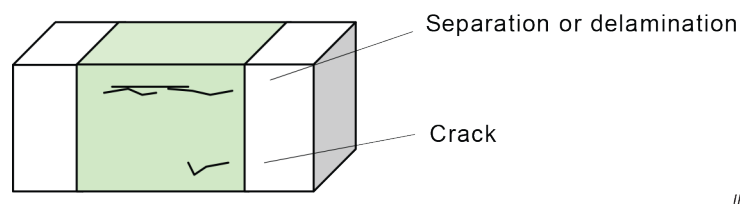


Figure 3 – Separation or delamination

- b) It shall not exhibit exposed electrodes between the two terminations (see Figure 4). It shall not exhibit any visible detachment of the metallized terminations nor any exposed electrodes (see Figure 4).

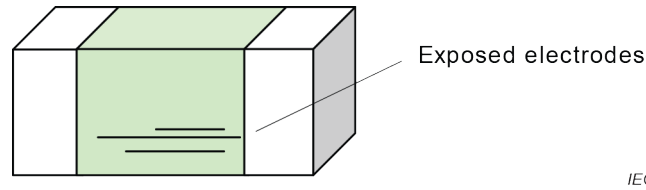


Figure 4 – Exposed electrodes

7.3.2.3 Requirements for the metallization

Requirements for the metallization are as follows:

The principal faces are those noted A, B, C, D and E (see Figure 5).

- a) Termination on bottom is the principal face noted C.
- b) Terminations on 3 sides are the principal faces noted A, B and C.
- c) Terminations on 5 sides are the principal faces noted A, B, C, D and E.

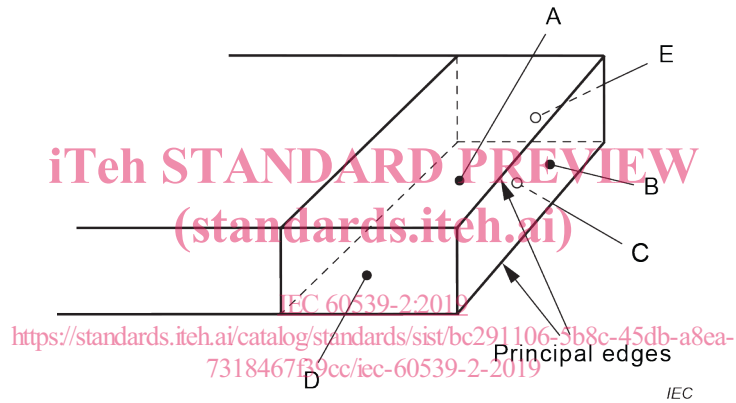


Figure 5 – Principal faces

The maximum area of gaps in metallization on each principal face shall not be greater than 15 % of the area of that face; these gaps shall not be concentrated in the same area. The gaps in metallization shall not affect the two principal edges of each extremity of the block (or four edges for square thermistors). Dissolution of the end-face plating (leaching) shall not exceed 25 % of the length of the edge concerned.

7.3.3 Marking

If there is marking on the body, it shall be legible as determined by visual examination.

- a) Gull wing terminations are noted F in Figure 6.

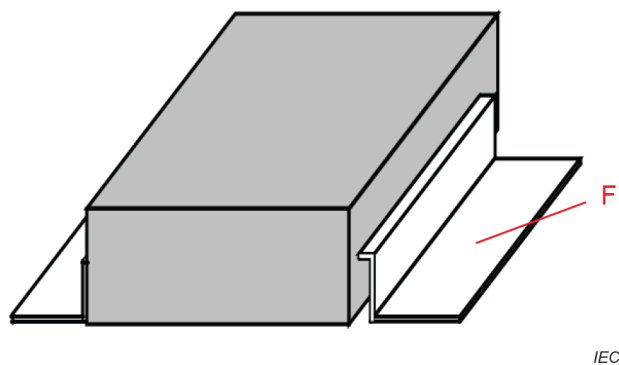


Figure 6 – Principal terminations – Gull wing

b) Round terminations are noted G in Figure 7.

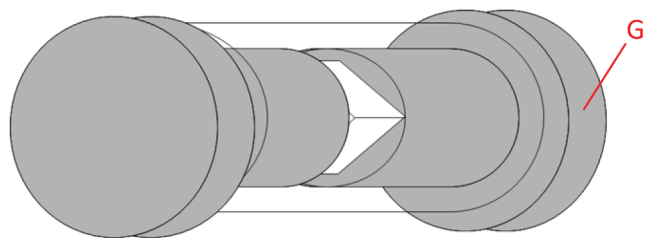


Figure 7 – Principal terminations – Round termination
(standards.iteh.ai)

The names of the structures of termination are in accordance with IEC 62137-3:2011.
<https://standards.iteh.ai/catalog/standards/sist/bc291106-5b8c-45db-a8ea-7318467f39cc/iec-60539-2-2019>

7.3.4 Dimensions

The dimensions indicated in the detail specification shall be checked and shall comply with the values prescribed in Annex A.

7.4 Electrical tests

7.4.1 Zero-power resistance

See IEC 60539-1:2016, 5.6, with the following details.

The zero-power resistance shall be measured at the temperature given in the detail specification and shall be within the limits specified in the detail specification, taking into account the tolerance.

7.4.2 *B*-value or resistance ratio

See IEC 60539-1:2016, 5.7, with the following details:

- calculate the *B*-value or the resistance ratio using zero-power resistance values measured at 25 °C and 85 °C, unless otherwise specified in the detail specification;
- the *B*-value or the resistance ratio shall be within the tolerance specified in the detail specification.

7.4.3 Resistance/temperature characteristic

See IEC 60539-1:2016, 5.10, with the following details:

- the measuring temperature shall be selected from those given in IEC 60539-1:2016, Table 1;