

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Fixed resistors for use in electronic equipment –
Part 8-1: Blank detail specification: Fixed surface mount (SMD) low power film
resistors for general electronic equipment, classification level G**

**Résistances fixes utilisées dans les équipements électroniques –
Partie 8-1: Spécification particulière cadre: Résistances fixes à couche et à faible
dissipation pour montage en surface (CMS), pour les équipements électroniques
universels, niveau G de classification**



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Part 8-1: Blank detail specification: Fixed surface mount (SMD) low power film
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIXED RESISTORS FOR USE IN ELECTRONIC EQUIPMENT –**Part 8-1: Blank detail specification:
Fixed surface mount (SMD) low power film resistors
for general electronic equipment, classification level G**

FOREWORD

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International Standard IEC 60115-8-1 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 1989 and constitutes a technical revision.

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

- It includes minor revisions related to tables, figures and references.

- Dedication to resistors of product classification level G, which is for general electronic equipment, typically operated under benign or moderate environmental conditions, like e.g. consumer products, or telecommunication user terminals.
- Implementation of the zero defect policy with the application of the single assessment level EZ in all test schedules.
- Substitution of the temperature coefficient of resistance (TCR), specified over the full defined temperature range, for the inferior and less significant temperature characteristic.
- Addition of a test for the immunity against electrostatic discharge.
- Implementation of the concept of stability classes with coordinated requirements to the performance at all prescribed tests.
- Addition of information relevant for the component user in his assembly process.
- Addition of an Annex providing special provisions for 0 Ω resistors (jumpers), which may be part of a range of products covered by a detail specification derived from this blank detail specification.

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

FDIS	Report on voting
40/2297/FDIS	40/2313B/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.

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

FIXED RESISTORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 8-1: Blank detail specification: Fixed surface mount (SMD) low power film resistors for general electronic equipment, classification level G

0 Introduction

COMMENT This introduction is not intended to be copied into the drafted detail specification. Therefore it is positioned prior to the conventional document structure and clause numbering range. It nevertheless contains normative requirements to the drafted detail specification.

0.1 Scope of this blank detail specification

This part of IEC 60115-8 is applicable to the drafting of detail specifications for fixed surface mount (SMD) low-power film resistors in rectangular chip shape (styles RR) or in cylindrical MELF shape (styles RC) classified to level G, which is defined in IEC 60115-8:2009, 1.5 for general electronic equipment, typically operated under benign or moderate environmental conditions, where the major requirement is function. Examples for level G include consumer products and telecommunication user terminals.

Another part of IEC 60115-8 provides a separate blank detail specification for the drafting of detail specifications for fixed surface mount (SMD) low-power film resistors in rectangular chip shape (styles RR) or in cylindrical MELF shape (styles RC) classified to level P.

Other parts of IEC 60115-8 may be issued to provide blank detail specifications for the drafting of detail specifications for surface mount resistors of other geometrical shapes, of other technologies or of other classification levels.

0.2 Function of this blank detail specification

A blank detail specification is a supplementary document to the sectional specification and contains requirements for style, layout and minimum contents of detail specifications. Detail specifications not complying with these requirements shall not be considered as being in accordance with IEC specifications nor shall they so be described.

The detail specification should contain a table of contents before the first page of the actual specification.

In the preparation of the detail specification, the content of IEC 60118-8:2009, 1.4 shall be taken into account. The detail specification should be written by using the preferred values given in IEC 60115-8.

Units, graphical symbols and letter symbols should, whenever possible, be taken from those prescribed by the following standards:

- IEC 60027-1, *Letter symbols to be used in electrical technology – Part 1: General*
- IEC 60617, *Graphical symbols for diagrams*
- ISO 80000 (all parts), *Quantities and units*

This blank detail specification uses for its purpose two different indications:

- NOTE For notes which give additional information intended to assist the understanding or use of the resulting document and therefore they shall be

copied as NOTE into the drafted detail specification. As outlined in the ISO/IEC directives, these notes shall not contain requirements, instructions, recommendations or permissions.

- COMMENT For editorial notes which are intended to aid and direct the specification writer, and therefore they shall not be copied into the drafted detail specification. In order to achieve their function, editorial notes require the use of instructions, recommendations and permissions.

0.3 Identification of the detail specification and the resistor

The first page of the detail specification should have a layout starting with a title block as recommended on the following page.

The numbers in square brackets are editorial references, which are not intended to be copied into the drafted detail specification. They correspond to the following information on the contents which shall be inserted in the indicated positions.

- [1] "International Electrotechnical Commission" or the name of the standardisation organisation under whose authority the detail specification is published and, if applicable, the organization from whom the detail specification is available.
- [2] The number allocated to the detail specification by the IEC or by the responsible standardisation organisation, together with the date of issue and issue number, as applicable.
Further reference details required by the responsible standardisation organisation or quality assessment system may be given here, including an established mark of conformity, as applicable.
- [3] The number and issue date and number, as applicable, of the relevant generic specification, sectional specification and blank detail specification, where the referenced issues shall be the most recent issues of the respective specifications.
- [4] The title of the detail specification, providing a short description of the type of resistors. This entry should support the discrimination between similar specifications and should be suitable for an entry in a register of approvals or in a catalogue of standards. It may duplicate information given in the textual scope in Clause 1.
- [5] An outline drawing or illustration of the products. This entry should aid the easy recognition of the resistors and, if possible, support the discrimination between similar specifications. It may duplicate information given in Figure 1.
- [6] Information on the typical construction of the resistors (where applicable). This entry may duplicate information given in the textual scope in Clause 1.
- [7] The classification level of the resistors covered by this detail specification, the level of quality assessment (assessment level EZ), and the general level of stability requirements at performance tests (stability class). This information may duplicate information given in the textual scope in Clause 1.
- [8] Optional field for table notes.

Specification available from:	[1]	IEC 60115-8-1 ...:	[2]
Electronic components of assessed quality in accordance with: IEC 60115-1: IEC 60115-8: IEC 60115-8-1:	[3]	Fixed low-power film surface mount (SMD) resistors for general electronic equipment, classification level G...	[4]
	[5]		[6]
		Product classification level G Assessment level EZ Stability classes ...	[7]
			[8]

COMMENT The remainder of this page is intentionally left empty in order to start Clause 1 on top of the next page..

Information about components qualified to this detail specification is available in the approvals section of the website <http://www.iecq.org>.

1 Scope

COMMENT The text of this clause may repeat information already given in some fields of the above title block.

This detail specification specifies the characteristics and ratings of fixed surface mount (SMD) resistors...

...

The resistors covered herein are classified to level G, as defined in IEC 60115-8: , 1.5 for general electronic equipment, typically operated under benign or moderate environmental conditions, where the major requirement is function. Examples for level G include consumer products and telecommunication user terminals.

This detail specification establishes test schedules and performance requirements for the quality assessment of the resistors covered herein according to the quality assessment procedures prescribed in IEC 60115-1: , Annex Q.

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 60062:2004, *Marking codes for resistors and capacitors*

IEC 60063, *Preferred number series for resistors and capacitors*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

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

IEC 60115-1:2008, *Fixed resistors for use in electronic equipment – Part 1: Generic specification*

IEC 60115-8:2009, *Fixed resistors for use in electronic equipment – Part 8: Sectional specification – Fixed surface mount resistors*

IEC 60286-3, *Packaging of components for automatic handling – Part 3: Packaging of surface mount components on continuous tapes*

IEC 60286-6, *Packaging of components for automatic handling – Part 6: Bulk case packaging for surface mounting components*

IEC 61760-1, *Surface mounting technology – Part 1: Standard method for the specification of surface mounting components (SMDs)*

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

COMMENT 1 The above list of normative references provides an example and needs to be adapted to the actual requirements of the drafted detail specification.

COMMENT 2 Dated references are required when reference is made to a specific part of the referenced standard, and generally they should be applied only in such cases.

COMMENT 3 It is recommended to update any dated references to the most recent revision of the referenced standard when drafting a detail specification. This involves updating of the dated normative references within the text of the drafted detail specification.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60115-1 and in IEC 60115-8, as well as the following, apply.

...

COMMENT The above statement should be reduced to "For the purposes of this document, the terms and definitions given in IEC 60115-1 and in IEC 60115-8 apply." if no further terms or definitions are required in the drafted detail specification.

4 Characteristics and ratings

4.1 General

Various parameters of this component are precisely defined in this specification. Unspecified parameters may vary from one component to another.

4.2 Dimensions

The shape and dimensions of the resistors covered by this specification are shown in Figure 1, with the specific styles and their respective dimensions given in Table 1. Other shapes are permissible within the given dimensions.



Figure 1 – Outline and dimensions

COMMENT 1 See IEC 60115-8:2009, 1.4.1.

COMMENT 2 The details shown in Figure 1 may repeat information already given in some fields of the title block above. Figure 1 in particular needs to define all dimensions to be prescribed in Table 1.

Table 1 – Styles and dimensions

Style		Dimensions			Mass ^b
Metric	X ^a	<i>L</i> mm	<i>W</i> mm	<i>T</i> mm	<i>m</i> mg
^a Historical style code, for information only.					
^b For information only.					

COMMENT 3 See IEC 60115-8:2009, 1.4.2.

COMMENT 4 The metric style designation is the normative designation used in all other places throughout this detail specification. Column X is an optional column for additional style information, e.g. for traditional imperial chip dimensions, which generally need to be marked with a respective table footnote, e.g. as “Historical style code, for information only”.

COMMENT 5 The dimensions for length *L*, width *W* and height *H* are given as example based on the requirements for rectangular chip resistors only and need to correspond to the dimensions identified in Figure 1. The choice of prescribed dimensions needs to be adapted to the actual requirements of the drafted detail specification and the shape of products covered therein. The dimensions may be given in the format of nominal values plus tolerance, or by stating permissible minimum and maximum values. Columns for additional dimensions may be inserted as required.

COMMENT 6 The component mass is not intended to be verified by an inspection procedure. It should be given as the maximum mass of a single component and should be marked with a respective table footnote as “For information only”.

4.3 Ratings

The climatic categories applied in this detail specification are given in Table 2.

Table 2 – Climatic categories

Climatic category
LCT / UCT / duration
... / ... / ...
... / ... / ...

COMMENT 1 See IEC 60115-8:2009, 1.4.3.

The upper category temperature (UCT), which is used for test procedures, should be based on the maximum element temperature (MET).

Table 3 – Ratings

Style	Rated dissipation P_{70} mW	X	Limiting element voltage d.c. or a.c. (r.m.s) $U_{\max}$ V	Insulation voltage d.c. or a.c. (peak) U_{ins} V

NOTE The insulation voltage U_{ins} is verified with a test duration of one minute. However, long time insulation properties may be affected by the influence of moisture, organic material and electrical field across the insulating layer(s).

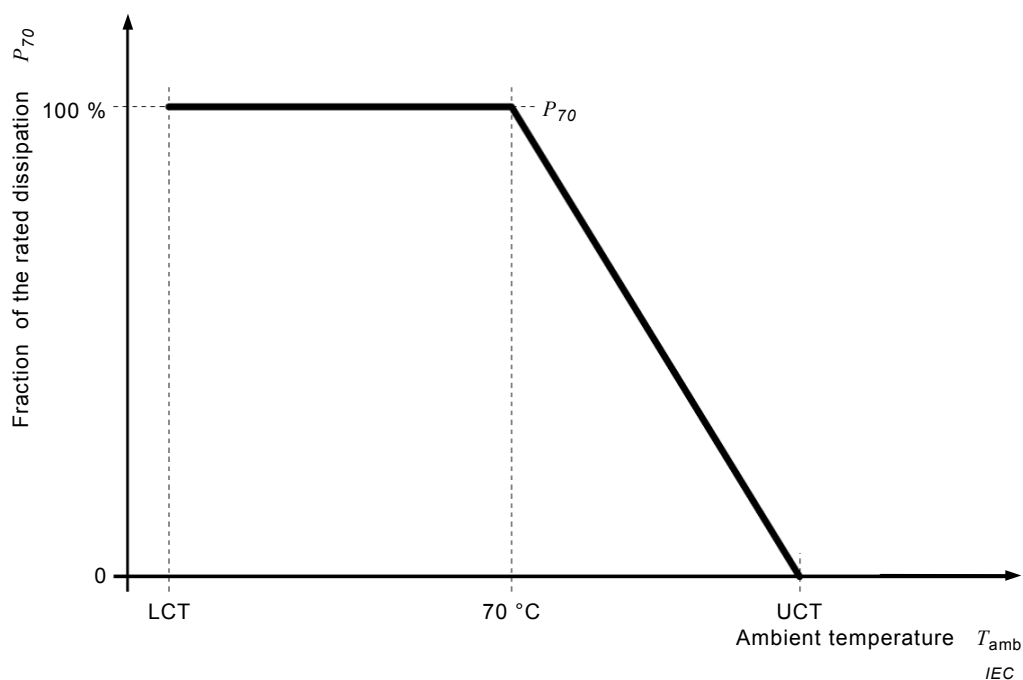
COMMENT 2 See IEC 60115-8:2009, 1.4.8, 1.4.9 and 1.4.10.

COMMENT 3 Column X is an optional column for additional information, e.g. an additional rated dissipation at another ambient temperature than the rated temperature 70 °C.

COMMENT 4 The insulation voltage shall not be specified lower than the peak voltage that can be applied continuously to the resistors and therefore shall not be rated less than $U_{\text{ins}} = 1,42 \cdot U_{\max}$.

COMMENT 5 Different sets of ratings may be assigned to variations of another parameter, e.g. climatic categories or stability classes. Then such different sets of ratings should be given in separate tables which need to be clearly assigned to the relevant parameter(s). Such duplicate tables may be titled e.g. as Table 3a, Table 3b, etc. as required.

The permissible dissipation of resistors covered by this detail specification is the rated dissipation as given in Table 3, which is derated for an ambient temperature above the rated temperature 70 °C according to the diagram in Figure 2.

**Figure 2 – Derating curve**

COMMENT 6 See IEC 60115-8:2009, 1.4.8.

COMMENT 7 The scale of derated dissipation may be given as absolute value in watt or relative in percent as a fraction of the rated dissipation P_{70} .

COMMENT 8 A larger area of operation or permissible temperature rise may be given by the detail specification, provided it includes all the area given in Figure 2.

4.4 Resistance range and tolerance on resistance

Table 4 gives the combinations of temperature coefficient, tolerance on resistance and resistance range which may be approved in climatic category ... / ... / ... according to this detail specification.

COMMENT 1 The above paragraph needs to be adapted to the actual requirements if more than one climatic category is applied in the drafted detail specification, see also COMMENT 5 below.

Products from the extent given in Table 4 shall be used for the initial product qualification approval according to 9.2, and for the quality conformance inspection according to 9.3.1.

The qualification of resistances below or above the specified resistance ranges is permissible if they fulfil the requirements of the stability class prescribed for the closest resistance within a specified range; e.g. resistors of style ... , ... · 10⁻⁶/K, ... %, ... Ω shall fulfil the requirements of stability class

COMMENT 2 The above paragraph may be deleted if individual extensions of the approvable resistance ranges is not considered suitable for the scope of the drafted detail specification.

The range of resistors approved in each style, together with the associated temperature coefficient and tolerance, shall be given in the register of approvals, as available for example on the website <http://www.iecq.org>.

**Table 4 – Temperature coefficients, tolerances and resistance ranges
for climatic category ... / ... / ...**

Style	Temperature coefficient		Tolerance		Resistance range Ω	E series ^b	Stability class
	10 ⁻⁶ /K	Code ^a	%	Code ^a			
^a Code letters according to IEC 60062. ^b Resistance values of the given E series according to IEC 60063 are							

COMMENT 3 See IEC 60115-8:2009, 1.4.5.

COMMENT 4 The column for the prescription of an E series is optional and may be deleted together with its related table footnote if the explicit recommendation of or limitation to resistance values of a particular E series is not suitable for the drafted detail specification. If used, the respective footnote to table needs to describe the recommendation or limitation associated with the given E series.

COMMENT 5 Different sets of resistance ranges may be assigned to different climatic categories, which should be given in separate tables, which then need to be clearly assigned to the respective climatic category. Such duplicate tables may be titled as Table 4a, Table 4b, etc., as required.

5 Tests and test severities

COMMENT 1 This clause is used to prescribe the severities of all tests demanded by the generic or sectional specification, which have not been prescribed in these superior specifications.

In addition, this clause should be used to prescribe in dedicated subclauses any additional test(s) not specified in the generic and/or sectional specification, and/or additional or increased test severities to those specified in the generic and/or sectional specification, wherever applicable to the scope of the drafted detail specification.

COMMENT 2 Owing to the space limitations in Tables 12 and 13, and to the need for unambiguous and consistent rulings, the prescriptions in this clause need to contain the full relevant information for each prescribed test. Consequentially, the “Conditions of test” in Tables 12 and 13 will only quote as much of the prescriptions as is required to provide a suitable overview.

5.1 Insulation resistance

See IEC 60115-1:2008, 4.6 and IEC 60115-8:2009, 2.2.5, with the following details:

Rectangular chip resistors, styles RR, shall be measured in a test jig as prescribed in IEC 60115-1:2008, 4.6.1.4, with the side of the resistive element (film side) facing up towards the spring loaded electrode (test point A). The radius of the spring loaded electrode shall not exceed one fourth of the length L of the chip resistor.

Cylindrical MELF resistors, styles RC, shall be measured in a test jig as prescribed in IEC 60115-1:2008, 4.6.1.5. Dimension L_1 of the V-shaped, spring loaded test block (test point A) shall be chosen to maintain a minimum distance to the resistor terminations of 0,5 mm or one fourth of the isolated length between the resistor's terminations, whichever is smaller.

COMMENT A specification will only cover either rectangular chip resistors or cylindrical MELF resistors, hence only the relevant paragraph should be used in the drafted detail specification.

5.2 Voltage proof

See IEC 60115-1:2008, 4.7 and IEC 60115-8:2009, 2.2.6, with the following details:

Rectangular chip resistors, styles RR, shall be tested in a test jig as prescribed in IEC 60115-1:2008, 4.6.1.4, with the side of the resistive element (film side) facing up towards the spring loaded electrode (test point A). The radius of the spring loaded electrode shall not exceed one fourth of the length L of the chip resistor.

Cylindrical MELF resistors, styles RC, shall be tested in a test jig as prescribed in IEC 60115-1:2008, 4.6.1.5. Dimension L_1 of the V-shaped, spring loaded test block (test point A) shall be chosen to maintain a minimum distance to the resistor terminations of 0,5 mm or one fourth of the isolated length between the resistor's terminations, whichever is smaller.

COMMENT A specification will only cover either rectangular chip resistors or cylindrical MELF resistors, hence only the relevant paragraph should be used in the drafted detail specification.

5.3 Variation of resistance with temperature

See IEC 60115-1:2008, 4.8, with the following details:

The test shall be performed with the specimens mounted according to the provisions of IEC 60115-8:2009, 2.4.2, or with unmounted specimens placed in a suitable fixture for the duration of the test.

The sequence of temperatures, 20 °C / LCT / 20 °C / UCT / 20 °C, shall be applied consecutively.

5.4 Short time overload

See IEC 60115-1:2008, 4.13 and IEC 60115-8:2009, 2.3.1, with the following detail:

The duration for which the overload is to be applied is a function of the resistor style, as given in Table 5.

Table 5 – Short time overload duration

Style	Overload duration t_{load} s

COMMENT A suitable tolerance needs to be specified with the prescribed overload duration t_{load} , preferably ± 10 % of the entered value. The tolerance however needs to be entered in the same unit as the duration, e.g. $(2 \pm 0,2)$ s.

NOTE The prescribed overload duration is determined in such a way that the resulting maximum temperature of the resistor exceeds the maximum element temperature, MET, as prescribed by this detail specification by no less than 30 K.

5.5 Temperature rise

See IEC 60115-1:2008, 4.14, with the following detail:

The specimens shall be mounted according to the provisions of IEC 60115-8:2009, 2.4.2.

5.6 Solderability

See IEC 60115-1:2008, 4.17 and IEC 60115-8:2009, 2.3.2, with the following detail:

The solderable termination surface of the resistors shall be compatible with both, traditional SnPb solder and lead-free solder. Therefore solderability testing is required for both soldering processes.

5.7 Resistance to soldering heat

The test and severity to be applied for testing resistance to soldering heat according to IEC 60115-1:2008, 4.18 and to IEC 60115-8:2009, 2.3.3 combine the conditions applicable to traditional SnPb solder and to lead-free solder, and reflect the requirements of reflow soldering, including vapour phase soldering, and double wave soldering:

Test method:	Solder bath method
Solder alloy:	any alloy SnPb or SnCu or SnAgCu or SnAg
Bath temperature:	$T_{bath} = (260 \pm 5) ^\circ\text{C}$
Immersion time:	$t_{imm} = (10 \pm 1) \text{ s}$
Immersion and withdrawal speed:	$v_{imm} = 20 \text{ mm/s to } 25 \text{ mm/s}$
Test cycles:	$n = 1$

5.8 Rapid change of temperature

See IEC 60115-1:2008, 4.19, with the following details:

The specimens shall be mounted according to the provisions of IEC 60115-8:2009, 2.4.2.

The test shall be applied with 5 cycles in group 6 of the test schedule for qualification approval (Table 12) and in group C1 of the test schedule for quality conformance inspection (Table 13).

The lower temperature, T_A , shall be the lower category temperature, LCT, and the higher temperature, T_B , shall be the upper category temperature, UCT.

5.9 Climatic sequence

COMMENT The special rulings of 5.9.2 and 5.9.3 will become obsolete once the respective clause in the generic specification, IEC 60115-1, 4.23, has been updated. Thereafter the special rules of 5.9.2 and 5.9.3 will no longer be required in drafted detail specifications.

5.9.1 General

See IEC 60115-1:2008, 4.23, with the following detail:

The specimens shall be mounted according to the provisions of IEC 60115-8:2009, 2.4.2.

5.9.2 Climatic sequence, dry heat

NOTE The 5th edition of IEC 60068-2-2 (published in 2007) deleted the test Ba, which has traditionally been used in the IEC 60115 series. As an interim solution, the 4th edition of IEC 60115-1 (published in 2008) referenced the 4th edition of IEC 60068-2-2 (published in 1974) in order to continue its use of test Ba. A suitable succession applying test Bb of IEC 60068-2-2 is under preparation for the next revision of the Generic Specification IEC 60115-1, from which the following replacement has been adopted.

For the purpose of this detail specification, the prescriptions of IEC 60115-1:2008, 4.23.2 shall be replaced by the following:

The resistors shall be subjected to test Bb of IEC 60068-2-2 and shall remain at the upper category temperature for a duration of 16 h.

The specimens may be introduced directly into the heated chamber at any temperature from laboratory temperature to the upper category temperature, and withdrawn directly from it, since the effects of the sudden change of temperature are not known to be detrimental to the specimen.

5.9.3 Climatic sequence, cold

NOTE The 6th edition of IEC 60068-2-1 (published in 2007) deleted the test Aa, which has traditionally been used in the IEC 60115 series. As an interim solution, the 4th edition of IEC 60115-1 (published in 2008) referenced the 5th edition of IEC 60068-2-1 (published in 1990) in order to continue its use of test Aa. A suitable succession applying test Ab of IEC 60068-2-1 is under preparation for the next revision of the Generic Specification IEC 60115-1, from which the following replacement has been adopted.

For the purpose of this detail specification, the prescriptions of IEC 60115-1:2008, 4.23.4 shall be replaced by the following:

The resistors shall be subjected to test Ab of IEC 60068-2-1 and shall remain at the lower category temperature for a duration of 2 h.

The specimens may be introduced directly into the cooled chamber at any temperature from the lower category temperature to laboratory temperature, and withdrawn directly from it, since the effects of the sudden change of temperature are not known to be detrimental to the specimen.

Precaution against condensation of moisture on the specimens is required if the specimens are inserted into the test chamber at a temperature below laboratory temperature.

5.9.4 Climatic sequence, low air pressure

The low air pressure test of the climatic sequence according to IEC 60115-1:2008, 4.23.5 shall be applied with the following details:

Air pressure: 8 kPa, with a relative tolerance of ± 20 %

Ambient temperature: 15 °C to 35 °C

Duration: 1 h ± 2 min.

5.9.5 Climatic sequence, damp heat, cyclic

The damp heat, cyclic test of the climatic sequence consists of a first cycle according to IEC 60115-1:2008, 4.23.3, and a number of remaining cycles depending on the climatic category according to IEC 60115-1:2008, 4.23.6.

Table 6 gives the number of remaining cycles for the climatic categories applied in this detail specification.

Table 6 – Remaining cycles of damp heat, cyclic test

Climatic category LCT / UCT / Duration	Number of cycles <i>n</i>	Number of remaining cycles <i>n-1</i>

5.9.6 Climatic sequence, DC load

See IEC 60115-1:2008, 4.23.7.

5.9.7 Climatic sequence, final measurements

See IEC 60115-1:2008, 4.23.8

For the measurement of the insulation resistance, see 5.1.

5.10 Damp heat, steady state test

See IEC 60115-1:2008, 4.24, with the following details:

The specimens shall be mounted according to the provisions of IEC 60115-8:2009, 2.4.2.

The test shall be executed for a duration given in Table 7, according to the climatic category.

Table 7 – Damp heat steady state test duration

Climatic category LCT / UCT / Duration	Duration <i>t_{exp}</i>

COMMENT A suitable tolerance needs to be specified with the prescribed duration *t_{exp}*, preferably + 4 h, e.g. (1 344 + 4) h. The potentially different units of duration and tolerance need to be observed, e.g. by writing 56 d + 4 h.

For the measurement of the insulation resistance, see 5.1.

5.11 Endurance at 70 °C

See IEC 60115-1:2008, 4.25.1, with the following detail:

The specimens shall be mounted according to the provisions of IEC 60115-8:2009, 2.4.2.

For the measurement of the insulation resistance, see 5.1.

5.12 Endurance at upper category temperature

See IEC 60115-1:2008, 4.25.3, with the following detail:

The test shall be performed with the specimens unmounted, or mounted according to the provisions of IEC 60115-8:2009, 2.4.2.

For the measurement of the insulation resistance, see 5.1.

5.13 Component solvent resistance test

The component solvent resistance test according to IEC 60115-1:2008, 4.29 and to the rulings of IEC 60115-8:2009, 2.3.7 shall be executed with the following details:

Solvent: IPA;
Solvent temperature: $T_{\text{bath}} = (23 \pm 5) ^\circ\text{C}$;
Conditioning: Method 2, without rubbing;
Duration of immersion: $t_{\text{imm}} = (5 \pm 0,5) \text{ min.}$

5.14 Solvent resistance of marking test

The solvent resistance of marking test according to IEC 60115-1:2008, 4.30 and to the rulings of IEC 60115-8:2009, 2.3.8 shall be executed with the following details:

Solvent: IPA;
Solvent temperature: $T_{\text{bath}} = (23 \pm 5) ^\circ\text{C}$;
Conditioning: Method 1, with rubbing;
Rubbing material: Cotton wool, or tooth brush;
Duration of immersion: $t_{\text{imm}} = (5 \pm 0,5) \text{ min.}$

The toothbrush prescribed as the rubbing device shall be a regular commercial hard grade quality with tightly clustered bristles of consistent length, made of regular synthetic fibres. It shall be used with a single solvent only and applied with normal hand pressure (approx. 0,5 N to 1 N normal to the specimen's surface) for the required ten strokes. The toothbrush shall be discarded when there is any evidence of softening, bending, wear, or loss of bristles.

5.15 Shear test

See IEC 60115-1:2008, 4.32 and IEC 60115-8:2009, 2.3.4, with the following details:

The specimens shall be mounted according to the provisions of IEC 60115-8:2009, 2.4.2.

The shear test force to be applied according to IEC 60115 8:2009, 2.3.4 is a function of the resistor style, as given in Table 8.

Table 8 – Shear test force

Style	Shear test force F_{test} N

COMMENT A suitable tolerance needs to be specified with the prescribed test force F_{test} , preferably $\pm 10\%$ of the entered value. The tolerance however needs to be entered in the same unit as the force, e.g. (10 ± 1) N.

NOTE The prescribed shear test force F_{test} is approximately proportional to the typical mass of the resistor of the respective style. It aims to exceed the force resulting from an acceleration of $100 \cdot g_n$ ($\approx 981 \text{ m/s}^2$), as would result from e.g. a shock or a bump applied to the assembled resistor.

5.16 Substrate bending test

The substrate bending test of IEC 60115-1:2008, 4.33 shall be applied with the following details:

The specimens shall be mounted according to the provisions of IEC 60115-8:2009, 2.4.2.

Deflection: $D = \dots \text{ mm}$

Number of bends: $n = \dots$

COMMENT Suitable values are $D = 2 \text{ mm}$ and $n = 3$.

The bends shall be applied consecutively. The substrate shall be maintained in the bent state for $(20 \pm 1) \text{ s}$ at each bend.

Resistance shall be measured in the bent position of the last bend.

5.17 Flammability

The needle-flame test according to IEC 60115-1:2008, 4.35 shall be executed with the following detail:

Duration of application: $t_a = 10 \text{ s}$, with a tolerance of $\begin{smallmatrix} 0 \\ -1 \end{smallmatrix} \text{ s}$.

5.18 Electrostatic discharge (ESD) test

See IEC 60115-1:2008, 4.38 and IEC 60115-8:2009, 2.3.6, with the following details:

The test shall be performed with the specimens mounted according to the provisions of IEC 60115-8:2009, 2.4.2, or with unmounted specimens placed in a suitable fixture for the duration of the test.

The ESD test voltage to be applied from a human body model is a function of the resistor style, as given in Table 9. The test voltage prescribed for any style shall be applied to the whole resistance range.

Table 9 – ESD test voltages

Style	ESD test voltage U_{HBM} V

COMMENT A suitable tolerance needs to be specified with the prescribed test voltage U_{HBM} , preferably $\pm 10\%$ of the entered value. The tolerance however needs to be entered in the same unit as the voltage, e.g. (500 ± 50) V.

The electrostatic discharge shall be applied to the specimens twice, once with positive and once with negative polarity. The minimum time between the two discharges shall be 1 s.

6 Performance requirements

COMMENT In addition to the prescription of requirements for the standard tests as demanded by the generic or sectional specification, this clause should be used to prescribe in dedicated subclauses any requirements to additional tests not specified in the generic and/or sectional specification, and/or additional or increased requirements to those specified in the generic and/or sectional specification, wherever applicable to the scope of the drafted detail specification.

6.1 Limits for change of resistance at tests

The permissible limits for the change of resistance at tests are given in Table 10 for the stability classes applied in this detail specification.

Table 10 –Limits for change of resistance

Stability class	Limit of resistance change, ΔR Ω			
	Long term tests		Short term tests	
	IEC 60115-1:2008	IEC 60115-1:2008	IEC 60115-1:2008	IEC 60115-1:2008
	4.23 Climatic sequence	4.25.1 Endurance at 70 °C; 1 000 h	4.13 Short time overload	4.38 Electrostatic discharge
	4.24 Damp heat, steady state		4.18 Resistance to soldering heat	
	4.25.3 Endurance at upper category temperature		4.19 Rapid change of temperature, 5 cycles	
			4.33 Substrate bending test	

COMMENT 1 See IEC 60115-8:2009, 1.4.4.

COMMENT 2 Tightening of individual requirements against the general requirements of the sectional specification IEC 60115-8 needs to be identified and indicated, e.g. by respective table footnotes.

6.2 Insulation resistance

NOTE The testing of insulation resistance and the respective requirements given in this subclause only applies to resistors which are described to be insulated.

For insulated resistors, the insulation resistance R_{ins} shall not be less than 1 G Ω when measured according to IEC 60115-1:2008, 4.6.

The insulation resistance R_{ins} shall not be less than 1 G Ω after each of the test:

- 4.25.1 of IEC 60115-1:2008, Endurance at 70 °C; and
- 4.25.3 of IEC 60115-1:2008, Endurance at upper category temperature.

The insulation resistance R_{ins} shall not be less than 100 M Ω after each of the test:

- 4.23 of IEC 60115-1:2008, Climatic sequence; and
- 4.24 of IEC 60115-1:2008, Damp heat, steady state.

6.3 Variation of resistance with temperature

The permissible limits for the reversible change of resistance at variation of resistance with temperature tests are given in Table 11 for the category temperatures applied in this detail specification.

Table 11 – Temperature coefficients and permissible change of resistance

Temperature coefficient			Limit of resistance change, $\Delta R/R$			
10 ⁻⁶ /K	Code ^a	X ^b	LCT / Reference temperature		Reference temperature / UCT	
			... °C / 20 °C	... °C / 20 °C	20 °C / ... °C	20 °C / ... °C
^a Code letters according to IEC 60062.						
^b Historical coding according to ... , for information only.						

COMMENT 1 See IEC 60115-8:2009, 1.4.7.

COMMENT 2 Column X is an optional column for additional TCR code information, e.g. from traditional specifications from prior the definitions of TCR codes as stated in the 2004 edition of IEC 60062, which generally needs to be marked with a respective table footnote, e.g. as "Historical coding, for information only".

COMMENT 3 Individual columns LCT / Reference temperature are required for each LCT, and individual columns Reference temperature / UCT for each UCT used in the drafted detail specification.

6.4 Temperature rise

The permissible temperature rise $\Delta T_{\max}$ for the temperature rise test according to IEC 60115-1:2008, 4.14 is determined by

$$\Delta T_{\max} = \text{MET} - 70 \text{ °C}$$

where

MET is the maximum element temperature.

6.5 Solderability

See IEC 60115-1:2008, 4.17.3.

The requirement to the visual inspection for the assessment of good solderability shall be:

≥95 % of the surface shall be covered with new solder. The new solder shall show no more than small amounts of scattered imperfections, such as pinholes or non-wetted or dewetted areas. These imperfections shall not be concentrated in one area.

6.6 Flammability

The duration of burning, t_b shall not exceed 30 s.

7 Marking, packaging and ordering information

7.1 Marking of the component

COMMENT Marking of the resistor can be mandatory or not. If marking of the resistor is prescribed in the drafted detail specification, the requirements of IEC 60115-1:2008, 2.4 and IEC 60115-8:2009, 1.4.12 need to be considered. The following text provides a suitable example for rectangular chip resistors (styles RR), which may be modified as required.

Surface mount resistors are generally not marked on the body. However, if marking is applied to the body, the resistor shall be marked with the nominal resistance using a letter and digit code according to IEC 60062:2004, Clause 4, preferably the four-character code according to IEC 60062:2004, 4.2.3.

7.2 Packaging

COMMENT 1 The prescriptions for packaging need to consider the requirements of IEC 60115-1:2008, 2.6. The following text provides a suitable example, which may be modified as required.

The resistors may be taped or put in a bulk case.

NOTE Environmental responsibility suggests the use of re-usable packaging like e.g. bulk cases.

Taping shall be in accordance with type of IEC 60286-3. Bulk case packaging shall be in accordance with IEC 60286-6.

COMMENT 2 Suitable prescriptions for the type of carrier tape according to IEC 60286-3 are type 1a, punched carrier tape (previously known as type I), for rectangular chip resistors (styles RR), and type 2a, blister carrier tape (previously known as type II), for cylindrical MELF resistors (styles RC).

7.3 Marking of the packaging

The packaging of resistors approved to this specification shall be marked with ordering information according to 7.4 and additionally with:

- mark of conformity, if appropriate;
- manufacturing date code, marking year and month or week, according to IEC 60062;
- manufacturing lot or batch number.

NOTE According to the IECQ Rules of Procedure, the right to use an IECQ mark of conformity is granted with a marks licence issued by the IECQ Certification Body upon completion of the qualification approval according to the provisions of this detail specification.

Additional information is permissible, for example

- manufacturer's name or trademark;
- manufacturer's type designation;
- quantity of the packaging unit.

All marking shall be applied unambiguously, so that no confusion can arise.

7.4 Ordering information

Orders for resistors approved to this specification shall contain the following minimum information:

- number of the detail specification;
- style reference;
- nominal resistance;
- tolerance on nominal resistance;

- temperature coefficient;
- form of delivery and packaging method.

8 Additional information

COMMENT 1 The detail specification may include additional information on the products covered therein. The information below should be given as a minimum.

COMMENT 2 Extensive information on properties not directly related to any rating, test or requirement covered in the normative clauses of the drafted detail specification should preferably be given in respective informative annexes.

8.1 General

The information provided in this clause does not constitute any rating, test or requirement and therefore is not intended to be verified by any inspection procedure.

8.2 Storage and transportation

COMMENT The detail specification should prescribe the permitted conditions and duration for storage with consideration of the conditions given in IEC 60115-1:2008, 2.7. Special permitted conditions and duration for transportation with consideration of IEC 60115-1:2008, 2.8 may be given here, if applicable. The following text provides a suitable example, which may be modified as required.

The permitted storage time is 10 years under the conditions of IEC 60115-1:2008, 2.7.

Solderability and resistance are the two properties which may be affected by storage. Therefore, a solderability test and a resistance measurement are recommended if the storage time exceeded one year.

8.3 Substrate for assembly

COMMENT The detail specification should give guidance on the substrates (ceramic substrates, printed circuit boards, foils, etc.) suitable to assemble the resistors. The following text provides an example, which may be modified as required.

The resistors are suitable for mounting on all common printed boards, ceramics and flexible foils.

8.4 Soldering process

COMMENT The detail specification should give guidance on the suitable soldering processes, preferably based on the description of soldering processes and their conditions given in IEC 61760-1. The following text provides an example, which may be modified as required.

The resistors are suitable for all soldering methods according to IEC 61760-1.

This includes full compatibility with

- lead-free solder, e.g. SnCu, SnCuNi, SnAg or SnAgCu,
- conventional SnPb solder.

The immersion time into a solder shall not exceed 10 s when the solder is heated to 260 °C.

It is recommended to use fluxes only, which do not require a cleaning process after soldering. Flux residues may be hard to remove, particularly from the space between the resistor and the circuit board or substrate. Flux residues may establish some conductivity in parallel to the assembled resistor and thereby adversely affect the performance of the electronic circuit.

8.5 Use of cleaning agents or solvents

COMMENT The detail specification should give guidance on the applicability of cleaning agents or solvents as normally used after component assembly. The following text provides an example, which may be modified as required.

For the removal of flux residues after soldering, the following agents may be used:

- alcohol, such as ethanol, propanol, isopropanol or butanol;
- aqueous solutions;
- deionized water.

The reaction time of the agent or solvent shall not exceed 5 min.

Consultation with the resistor manufacturer is recommended if the use of other cleansing agents is intended.

8.6 Coating or potting after assembly

COMMENT The detail specification should give guidance on the applicability of conformal coating or potting of the assembled resistors. The following text provides an example, which may be modified as required.

Consultation with the resistor manufacturer is recommended if the use of a conformal coating or potting is intended.

The suitability of a conformal coating or potting shall be qualified by appropriate means prior to its use in order to ensure the long-term stability of the assembled system.

NOTE It is common for many fields of application to aim at improved protection from environmental influences through utilization of a conformal coating or a potting on the assembled circuit board. This, however, poses most stringent requirements to the cleanliness of the assembly, since any remaining ionic contamination together with water vapour naturally diffusing through the coating layer is likely to enable electrochemical migration, corrosion, or other detrimental effects in the direct vicinity of any assembled component.

9 Quality assessment procedures

9.1 General

9.1.1 100 % test

All resistors according to this specification are subject to a 100 % test during the manufacturing process. The following tests shall be performed:

Resistance and tolerance on rated resistance shall be measured according to IEC 60115-1:2008, 4.5 during the manufacturing process, resulting in the removal of all nonconforming items.

This test shall be followed by re-inspection by sampling in order to monitor the outgoing quality level, to be expressed in non-conforming units per million (10^{-6}). The sampling level shall be established by the manufacturer, preferably according to IEC 61193-2:2007, Annex A. The statistically verified quality limit (SVQL) shall be calculated by accumulating inspection data according to the method given in IEC 61193-2:2007, 6.2.

All non-conforming units shall be considered for the calculation of the quality level values.

A lot shall be rejected if one or more non-conforming units occur in the sample.

9.1.2 Certificate of conformity (CoC)

The conformity is declared by marking the packaging in accordance with the relevant system rules, if components are qualified to this specification by a certification body of a quality assessment system (e.g. IECQ).

NOTE Such prescribed conformity marking typically involves the use of a specific mark of conformity, the use of which is regulated by a marks licence, granted only upon an achieved approval.

An additional certificate of conformity is not required for qualified components.

9.1.3 Certified test records of released lots

Certified test records according to IEC 60115-1, Clause Q.9 can be supplied if agreed upon between customer and manufacturer.

9.2 Qualification approval

The fixed sample size procedure according to IEC 60115-1:2008, Q.5.3 and according to IEC 60115-8:2009, 3.4.1 shall be used for the initial product qualification approval. The product qualification shall be performed according to the test schedule given in Table 12, with the details and severities of the tests given in Clause 5 and the respective requirements given in Clause 6.

Inspection lots shall be formed according to IEC 60115-8:2009, 3.3.

The qualification approval shall be granted after successful completion of all the test of Table 12.

9.3 Maintenance of a qualification approval

9.3.1 Quality conformance inspection

The product quality conformance inspections shall be performed according to IEC 60115-1:2008, Q.5.6 and according to IEC 60115-8:2009, 3.5, using the test schedule of Table 13 for the lot-by-lot tests and for the periodic tests, with the details and severities of the tests given in Clause 5 and the respective requirements given in Clause 6.

Inspection lots shall be formed according to IEC 60115-8, 3.3.

9.3.2 Non-conforming specimen

All tests of a sub-group shall be repeated on a new sample if one non-conforming item is obtained during quality conformance inspection tests. Then no non-conforming items are permitted. Release of products may continue during repeat testing.

For mounted specimens, any specimen found defective after mounting shall not be taken into account when calculating the permissible non-performing items for the succeeding tests. They shall be replaced by spare parts.