INTERNATIONAL STANDARD

IEC 61051-1

QC 420000

Second edition
2007-04

Varistors for use in electronic equipment –

Part 1:
Generic specification

Reference number
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Commission Electrotechnique Internationale
International Electrotechnical Commission
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

VARISTORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 1: Generic specification

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International Standard IEC 61051-1 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 1991 and constitutes a minor revision related to tables, figures and references.

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

CDV	Report on voting
40/1775/CDV	40/1841/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.

The QC number that appears on the front cover of this publication is the specification number in the IEC Quality Assessment System for Electronic Components (IECQ).

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

The list of all the parts of the IEC 61051 series, under the general title *Varistors for use in electronic equipment*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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- withdrawn,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.

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

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VARISTORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 1: Generic specification

1 General

1.1 Scope

This part of IEC 61051 is applicable to varistors with symmetrical voltage-current characteristics for use in electronic equipment.

1.2 Object

The object of this standard is to establish standard terms, inspection procedures and methods of test for use in sectional and detail specifications for Qualification Approval and for Quality Assessment Systems for electronic components.

1.3 Normative references

The following referenced documents are indispensable for the application 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 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050 (all parts), *International Electrotechnical Vocabulary (IEV)*

IEC 60060-2:1994, *High-voltage test techniques – Part 2: Measuring systems*

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

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*
Amendment 1 (1992)

IEC 60068-2-1:2007, *Environmental testing – Part 2: Tests – Test A: Cold*

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Tests B: Dry heat*
Amendment 1 (1993)
Amendment 2 (1994)

IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc and guidance: Vibration (Sinusoidal)*

IEC 60068-2-13:1983, *Environmental testing – Part 2: Tests – Test M: Low air pressure*

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests – Test N: Change of temperature*
Amendment 1 (1986)

IEC 60068-2-20:1979, *Environmental testing – Part 2: Tests – Test T: Soldering*
Amendment 2 (1987)

IEC 60068-2-21:2006, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27:1987, *Environmental testing – Part 2: Tests – Test Ea and guidance: Shock*

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IEC 60068-2-29:1987, *Environmental testing – Part 2: Tests – Test Eb and guidance: Bump*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db and guidance: Damp heat, cyclic (12 h + 12-hour cycle)*

IEC 60068-2-45:1980, *Environmental testing – Part 2: Tests – Test XA and guidance – Immersion in cleaning solvents*

IEC 60068-2-54:2005, *Environmental testing – Part 2-54: Tests – Test Ta: Solderability testing of electronic components by the wetting balance method*

IEC 60068-2-58:2004, *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 60068-2-69:1995, *Environmental testing – Part 2: Tests – Test Te: Solderability testing of electronic components for surface mount technology by the wetting balance method*

IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60294:1969, *Measurement of the dimensions of a cylindrical component having two axial terminations*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 60617:2007, *Graphical symbols for diagrams*

IEC 60695-11-5:2004, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60717:1981, *Method for the determination of the space required by capacitors and resistors with unidirectional terminations*

IEC 61249-2-7:2002, *Materials for printed boards and other interconnecting structures – Part 2-7: Reinforced base materials clad and unclad – Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test) copper-clad*

IEC QC 001002-3, see http://www.iecq.org

ISO 1000:1992, *SI units and recommendations for the use of their multiples and of certain other units*

Amendment 1 (1998)

2 Technical data

2.1 Units, symbols and terminology

Units, graphical symbols, letter symbols and terminology shall, whenever possible be taken from the following publications:

IEC 60027

IEC 60050

IEC 60617

ISO 1000

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When further items are required they shall be derived in accordance with the principles of the documents listed above.

2.2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.2.1
type
group of components having similar design features and the similarity of whose manufacturing techniques enables them to be grouped together either for qualification approval or for quality conformance inspection

They are generally covered by a single detail specification.

NOTE Components described in several detail specifications may, in some cases, be considered as belonging to the same type and may therefore be grouped together for approval and quality conformance inspection.

2.2.2
style
subdivision of a type, generally based on dimensional factors which may include several variants, generally of a mechanical order

2.2.3
varistor (voltage dependent resistor, VDR) (graphical symbol Z)
component, whose conductance, at a given temperature, increases rapidly with voltage. This property is expressed by either of the following formulae:

$$U = CI^{\beta} \quad (1)$$

or

$$I = AU^{\gamma} \quad (2)$$

where

I is the current flowing through the varistor;

U is the voltage applied across the varistor;

β is the current index;

γ is the voltage index;

A and C are constants.

2.2.4
non-linearity current index β
starting from formula (1) of 1.5.3, it is defined by the formula:

$$\beta = \frac{I}{U} \times \frac{\mathrm{d}U}{\mathrm{d}I} \quad (3)$$

For the convenience of calculation, the following formula may be used:

$$\beta = \frac{I\mathrm{g}(U_1/U_2)}{I\mathrm{g}(I_1/I_2)} \quad (4)$$

β is always less than 1.

2.2.5
non-linearity voltage index γ
starting from formula (2) of 1.5.3, it is defined by the formula:

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$$\beta = \frac{U}{I} \times \frac{\mathrm{d}I}{\mathrm{d}U} \tag{5}$$

For the convenience of calculation, the following formula may be used:

$$\gamma = \frac{lg(I_1/I_2)}{lg(U_1/U_2)} \tag{6}$$

γ is always greater than 1.

2.2.6
maximum continuous a.c. voltage
maximum a.c. r.m.s. voltage of a substantially sinusoidal waveform (less then 5 % total harmonic distortion) which can be applied to the component under continuous operating conditions at 25 °C. At temperatures greater than 25 °C the detail specification must give full information on derating requirements.

Normally this voltage value shall be 1,1 times the supply voltage.

2.2.7
maximum continuous d.c. voltage
maximum d.c. voltage (with less than 5 % ripple) which can be applied to the component under continuous operating conditions at an ambient temperature of 25 °C. At temperatures greater than 25 °C the detail specification must give full information on derating requirements.

2.2.8
supply voltage
voltage by which the system is designated and to which certain operating characteristics of the system are referred

2.2.9
nominal varistor voltage
voltage, at specified d.c. current, used as a reference point in the component characteristic

2.2.10
voltage-under-pulse conditions
peak value of the voltage, which appears at the terminations of the varistor, when a specified current pulse is applied to it

2.2.11
clamping voltage
peak voltage developed across the varistor terminations under standard atmospheric conditions, when passing an 8/20 class current pulse (see 1.5.15)

2.2.12
isolation voltage (applicable only to insulated varistors)
maximum peak voltage, which may be applied under continuous operating conditions between the varistor terminations and any conducting mounting surface

2.2.13
leakage current
current passing through the varistor at the maximum d.c. voltage and at a temperature of 25 °C or at any other specified temperature

2.2.14
maximum peak current
maximum current per pulse, which may be passed by a varistor at an ambient temperature of 25 °C, for a given number of pulses

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2.2.15
class current
peak value of current, which is 1/10 of the maximum peak current for 100 pulses at two per minute for the 8/20 pulse

2.2.16
pulse or impulse
unidirectional wave of voltage or current without appreciable oscillations

NOTE In IEC 60060-2, the word "impulse" is used; however, for this specification, only the word "pulse" is used.

2.2.17
pulse currents
two types of pulse currents are used:

1. The first type has a shape which increases from zero to a peak value in a short time, and thereafter decreases to zero either approximately exponentially or in the manner of a heavily damped sine curve. This type is defined by the virtual front time T_1 and the virtual time to half-value T_2; see Figure 1. The pulse voltage of combination pulse (see 2.2.29) has a similar shape.

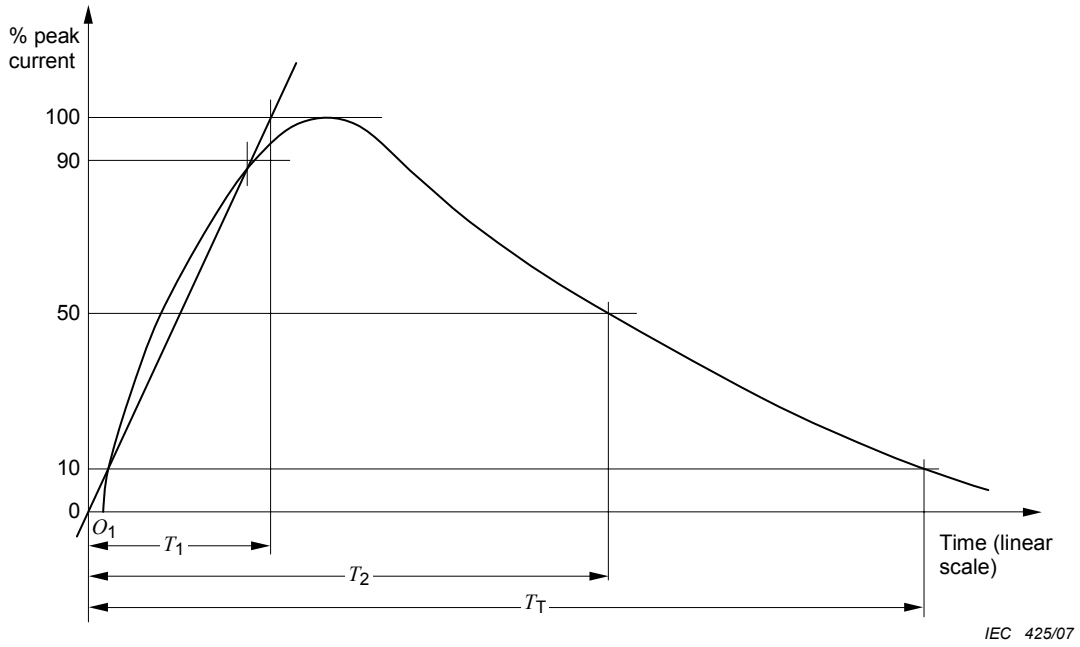

Figure 1 – Shape of pulse current type 1

2. The second type has an approximately rectangular shape and is defined by the virtual duration of the peak and the virtual total duration; see Figure 2.

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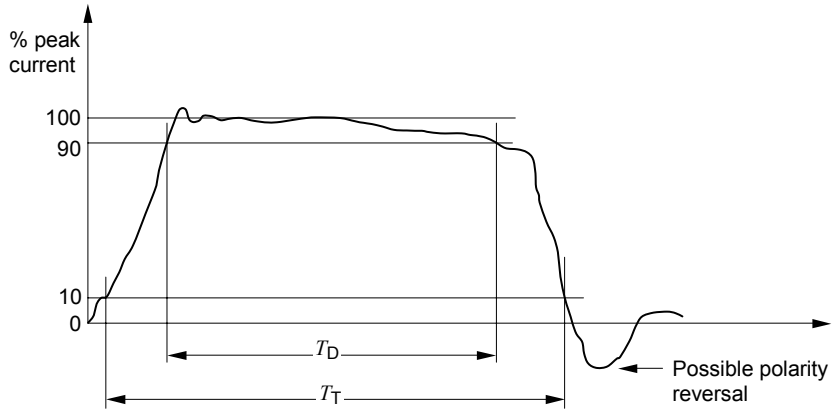

T_D Virtual duration of peak current

T_T Virtual total duration

Figure 2 – Shape of pulse current type 2

2.2.18
value of the pulse current
pulse current is normally defined by its peak value. With some test circuits, overshoot or oscillations may be present on the current. The pulse current shall be defined by a smooth curve drawn through the oscillations provided the peaks of the oscillations comply with 4.6.2

2.2.19
virtual front time T_1
virtual front time T_1 of a pulse current is 1,25 times the interval between the instants when the pulse is 10 % and 90 % of its peak value. The virtual front time T_1 of a pulse voltage is 1,67 times the interval between the instants when the pulse is 30 % and 90 % of its peak value

2.2.20
virtual origin O_1
virtual origin O_1 of a pulse current is the instant preceding at which the current is 10 % of its peak value by a time $0{,}1 \times T_1$. The virtual origin O_1 of a pulse voltage is the instant preceding that at which the voltage is 30 % of its peak value by a time $0{,}3 \times T_1$.

For oscillograms having linear time sweeps, this is the intersection with the X-axis of a straight line drawn through the 10 % (30 %, in case of pulse voltage) and 90 % reference points on the front.

2.2.21
virtual time to half-value T_2
virtual time to half-value T_2 of a pulse current or pulse voltage is the time interval between the virtual origin and the instant on the tail at which the current has first decreased to half its peak value

2.2.22
virtual duration of peak of a rectangular pulse current t_d
time during which the current is greater than 90 % of its peak value

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2.2.23
virtual total duration t_t of a pulse current
time during which the amplitude of the pulse is greater than 10 % of its peak value. If oscillations are present on the front, a mean curve should be drawn in order to determine the time at which the 10 % value is reached

2.2.24
category temperature range
range of ambient temperatures for which the varistor is designed to operate continuously; this is defined by the temperature limits of its appropriate climatic category

2.2.25
upper category temperature
maximum ambient temperature for which a varistor has been designed to operate continuously:

– either, for varistors of metal oxide construction, at that portion of the maximum continuous a.c. or d.c. voltage which is indicated in the derating curve given in the detail specification;

– or, if appropriate, for varistors of silicon carbide construction, at that portion of the rated dissipation which is indicated in the category dissipation

2.2.26
lower category temperature
minimum ambient temperature at which a varistor has been designed to operate continuously

2.2.27
thermal resistance
ratio between the temperature rise of the element of the varistor above the ambient temperature and the applied power

2.2.28
rated dissipation
maximum allowable dissipation at an ambient temperature of 25 °C

2.2.29
combination pulse
pulse with voltage waveform of 1,2/50 (T_1/T_2) and current waveform of 8/20 (T_1/T_2), which is expressed by “peak voltage/peak current”

2.3 Preferred values and characteristics

Each sectional specification shall prescribe the preferred values appropriate to the subfamily, covered by that sectional specification.

2.4 Marking

2.4.1 General

The information given in the marking is normally selected from the following list; the relative importance of each item being indicated by its position in the list:

a) maximum continuous a.c. voltage or nominal varistor voltage;

b) date of manufacture;

c) number of the detail specification and style reference;

d) manufacturer's name or trade mark.

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The varistor shall be clearly marked with a) above and with as many of the remaining items as is practicable. Any duplication of information in the marking on the varistor should be avoided.

In the case of extremely small components, the sectional specification shall prescribe the requirements.

The package containing the varistor(s) shall be clearly marked with all the information listed above.

Any additional marking shall be so applied that no confusion can arise.

2.4.2 Coding

When coding is used, the method shall be preferably selected from those given in IEC 60062.

3 Quality assessment procedures

3.1 Qualification approval/quality assessment systems

When these documents are being used for the purpose of a full quality assessment system such as the IEC Quality Assessment System for Electronic Components (IECQ), with Qualification Approval and Quality Conformance Inspection, the procedures of 3.4 and 3.5 shall be complied with.

When these documents are used outside such quality assessment systems as the IECQ system for purposes such as design proving or type testing, the procedures and requirements of 3.4.1 and 3.4.2 b) may be used, but the tests and parts of tests shall be applied in the order given in the test schedules.

3.2 Primary stage of manufacture

For varistor specifications, the primary stage of manufacture is the mixing of ingredients.

3.3 Structurally similar components

Varistors within the scope of this specification may be grouped as structurally similar for the purpose of forming inspection lots provided that the following requirements are met.

a) They shall be produced by one manufacturer on one site using essentially the same design, materials, processes and methods

b) For electrical tests, devices having the same electrical characteristics may be grouped provided that the element determining the characteristics is similar for all the devices concerned

c) For environmental tests, devices having the same encapsulation, basic internal structure and finishing processes may be grouped

d) For visual inspection (except marking) devices may be grouped if they have been made on the same production line, have the same dimensions encapsulation and external finish.

   The grouping may also be used for robustness of terminations and soldering tests where it is convenient to group devices with different internal structures (see c) above).

e) For endurance tests, devices may be grouped if they have been made with the same production process in the same location using the same design and differing only in electrical characteristics. If it can be shown that one type from the group is more heavily stressed than the others then tests on this type may be accepted for the remaining members of the group.

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3.4 Qualification approval procedures

The manufacturer shall comply with

– the general requirements of the rules of procedure governing qualification approval (IEC QC 001002-3, Clause 3);

– the requirements for the primary stage of manufacture which is defined in 3.2 of this standard.

In addition to the requirements of procedures a) or b) below, the following shall apply.

a) The manufacturer shall produce test evidence of conformance to the specification requirements on three inspection lots for lot-by-lot inspection taken in as short a time as possible and one lot for periodic inspection. No major changes in the manufacturing process shall be made in the period during which the inspection lots are taken.

   Samples shall be taken from the lots in accordance with IEC 60410 (see Annex B). Normal inspection shall be used, but when the sample size would give acceptance on zero non-conformances, additional specimens shall be taken to meet the sample size required to give acceptance on one nonconforming item.

b) The manufacturer shall produce test evidence to show conformance to the specification requirements on the fixed sample size test schedule given in the Sectional Specification.

   The specimens taken to form the sample shall be selected at random from current production or as agreed with the National Supervising Inspectorate.

Qualification Approval obtained as part of a Quality Assessment System shall be maintained by regular demonstration of compliance with the requirements for Quality Conformance (see 3.5). Otherwise, this qualification approval shall be verified by the rules for the maintenance of qualification approval given in the Rules of Procedure of the IEC Quality Assessment System for Electronic Components (IEC QC 001002-3, 3.1.7).

3.5 Quality conformance inspection

The blank detail specification(s) associated with a sectional specification shall prescribe the test schedule for Quality Conformance Inspection.

This schedule shall also specify the grouping, sampling and periodicity for the lot-by-lot and periodic inspection.

Inspection Levels and AQLs shall be selected from those given in IEC 60410.

If required, more than one test schedule may be specified.

3.5.1 Certified records of released lots

When certified records of released lots are prescribed in the relevant specification and are requested by a purchaser, the following information shall be given as a minimum.

– Attributes information (i.e. number of components tested and numbers of nonconforming components) for tests in the subgroups covered by periodic inspection without reference to the parameter for which rejection was made.

– Variables information for the change in voltage or in current after the endurance test specified in the sectional specification.

3.5.2 Delayed delivery

Varistors held for a period exceeding two years (unless otherwise specified in the sectional specification), following the release of the lot shall, before delivery, be re-examined for visual examination, solderability and voltage at a leakage current of 1 mA as specified in Group A or B inspection of the detail specification.

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As the effect of change in voltage or current is dependent on the kind of varistor, its value and initial tolerance, the procedure adopted by the manufacturer's Chief Inspector to ensure that the voltage requirement at a leakage current of 1 mA is fulfilled, shall be approved by the National Supervising Inspectorate.

Once a "lot" has been satisfactorily re-inspected, its quality is re-assured for the specified period.

3.5.3 Release for delivery before the completion of Group B tests

When the conditions of IEC 60410 for changing to reduced inspection have been satisfied for all Group B tests, the manufacturer is permitted to release components before the completion of such tests.

3.6 Alternative test methods

The test and measurement methods given in the relevant specification are not necessarily the only methods which can be used. However, the manufacturer shall satisfy the National Supervising Inspectorate that any alternative methods which he may use will give results equivalent to those obtained by the methods specified. In case of dispute, for referee and reference purposes, only the specified methods shall be used.

3.7 Unchecked parameters

Only those parameters of a component which have been specified in a detail specification and which were subject to testing can be assumed to be within the specified limits.

It should not be assumed that any parameter not specified will remain unchanged from one component to another. Should for any reason it be necessary for (a) further parameter(s) to be controlled, then a new, more extensive, specification should be used.

The additional test method(s) shall be fully described and appropriate limits, AQLs and inspection levels specified.

4 Test and measurement procedures

4.1 General

The sectional and/or blank detail specifications shall contain tables showing the tests to be made, which measurements are to be made before and after each test or subgroup of tests, and the sequence in which they shall be carried out. The stages of each test shall be carried out in the order written. The measuring conditions shall be the same for initial and final measurements.

If national specifications within any Quality Assessment System include methods other than those specified in the above documents, they shall be fully described.

The issue and amendment status of any IEC 60068 test in this clause is given in 1.3.

4.2 Standard atmospheric conditions

4.2.1 Standard atmospheric conditions for testing

Unless otherwise specified, all tests and measurements shall be made under standard atmospheric conditions for testing as given in 5.3 of IEC 60068-1:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 75 %

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Air pressure: 86 kPa to 106 kPa

Before the measurements are made, the varistor shall be stored at the measuring temperature for a time sufficient to allow the entire varistor to reach this temperature. The same period as is prescribed for recovery at the end of a test is normally sufficient for this purpose.

When measurements are made at a temperature other than the specified temperature, the results shall, when necessary, be corrected to the specified temperature. The ambient temperature during the measurements shall be stated in the test report. In the event of a dispute, the measurements shall be repeated using one of the referee temperatures (as given in 4.2.3) and such other conditions as are prescribed in this specification.

When tests are conducted in a sequence, the final measurements of one test may be taken as the initial measurements for the succeeding test.

NOTE During measurements the varistor should not be exposed to draughts, direct sun rays or other influences likely to cause error.

4.2.2 Recovery conditions

Unless otherwise specified, recovery shall take place under the standard atmospheric conditions for testing (see 4.2.1). If recovery has to be made under closely controlled conditions, the controlled recovery conditions of 5.4.1 of IEC 60068-1 shall be used.

4.2.3 Referee conditions

For referee purposes one of the standard atmospheric conditions for referee tests taken from 5.2 of IEC 60068-1, as given in Table 1, shall be chosen.

Table 1 – Standard atmospheric conditions

Temperature °C	Relative humidity %	Air pressure kPa
20 ± 1	63 to 67	86 to 106
23 ± 1	48 to 52	86 to 106
25 ± 1	48 to 52	86 to 106
27 ± 1	63 to 67	86 to 106

4.2.4 Reference conditions

For reference purposes, the standard atmospheric conditions for reference given in 5.1 of IEC 60068-1 apply:

Temperature: 20 °C

Air pressure: 101,3 kPa

4.3 Drying and recovery

Where drying is called for in the specification, the varistor shall be conditioned before measurement is made, using procedure I or procedure II as called for in the detail specification.

Procedure I

For 24 h ± 4 h in an oven at a temperature of 55 °C ± 2 °C and relative humidity not exceeding 20 %.

Procedure II

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For 96 h ± 4 h in an oven at 100 °C ± 5 °C.

The varistor shall then be allowed to cool in a desiccator using a suitable desiccant, such as activated alumina or silica gel, and shall be kept therein from the time of removal from the oven to the beginning of the specified tests.

4.4 Visual examination and check of dimensions

4.4.1 Visual examination

The condition, workmanship and finish shall be satisfactory as checked by visual examination.

4.4.2 Marking

Marking shall be legible, as checked by visual examination. It shall conform to the requirements of the detail specification.

4.4.3 Dimensions (gauging)

The dimensions indicated in the detail specification as being suitable for gauging shall be checked, and shall comply with the values prescribed in the detail specification.

When applicable, measurements shall be made in accordance with IEC 60294 or IEC 60717.

4.4.4 Dimensions (detail)

All dimensions prescribed in the detail specification shall be checked and they shall comply with the values prescribed.

4.5 Nominal varistor voltage or leakage current (not applicable to pulse measurements)

4.5.1 Test procedure

The varistors shall be fixed in corrosion-resistant clamps by their usual means. A preferred means of mounting is given in Annex A for measurements in air and when self-heating may occur. The method in Annex A shall be used in case of dispute.

4.5.2 Measurement and requirements

Measurement of nominal varistor voltage or leakage current shall be made by using a direct voltage (or current) for as short a time as practicable, in order that the temperature of the varistor element does not rise appreciably during measurement.

Where more precise conditions of measurement are required, they shall be prescribed in the detail specification.

The measurement shall be made in two directions.

The accuracy of the measuring equipment shall be such that the error does not exceed 10 % of the tolerance.

The measured value of nominal varistor voltage (or leakage current) shall comply with the limits given in the detail specification.

4.6 Pulse current

The varistors shall be fixed in corrosion resistant clamps by their usual means. A preferred means of mounting is given in Annex A for measurements in air and when self-heating may occur. The method in Annex A shall be used in case of dispute.

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4.6.1 Standard pulse currents

Two standard pulse currents corresponding to the first type of pulse defined in 1.5.17 are used. One has a virtual front time of 8 μs and a time to half-value of 20 μs; it is described as an 8/20 pulse. The other has a virtual front time of 10 μs and a time to half-value of 1 000 μs; it is described as a 10/1 000 pulse.

Rectangular pulse currents, corresponding to the second type of pulse defined in 1.5.17 have virtual durations of the peak equal, within the specified tolerances, to 50 μs, 1 000 μs or 2 000 μs.

4.6.2 Tolerances

Table 2 lists the differences that are accepted between specified values for the pulse currents and those actually recorded, provided that the measuring system meets the requirements of IEC 60060-2.

Table 2 – Accepted differences between specified and recorded pulse current values

	For 8/20	For 10/1 000
Peak value	± 10 %	± 10 %
Virtual front time T_1	± 10 %	$^{+100}_{-10}$ %
Virtual time to half value T_2	± 10 %	± 20 %
Virtual total duration		2,5 to 4 times T_2

A small overshoot or oscillations are tolerated provided that their single-peak amplitude in the neighbourhood of the peak of the pulse is not more than 5 % of the peak value. Any polarity reversal after the current has fallen to zero should not be more than 20 % of the peak value.

For rectangular pulses:

Peak value $^{+20}_{0}$ %

Virtual duration of the peak $^{+20}_{0}$ %

An overshoot or oscillation is tolerated provided that its peak amplitude is not more than 10 % of the peak value. The total duration of a rectangular pulse should not be larger than 1,5 times the virtual duration of the peak and the polarity reversal should be limited to 10 % of the peak value.

NOTE The above-mentioned tolerances relate to the measuring system which create the pulse (measuring system in short circuit) and not to the recorded pulse during the testing.

4.6.3 Measurement of the pulse current

The pulse current should be measured by a device which has passed the approval procedure referred to in IEC 60060-2. The pulse shall be as defined in the detail specification.

4.7 Voltage under pulse condition

The varistors shall be placed in corrosion-resistant clamps by their usual means. A preferred means of mounting is given in Annex A for measurements in air and when self-heating may occur. The method in Annex A shall be used in case of dispute.

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When measurements are required of the voltages developed across the test object during tests with high pulse currents, any of the approved devices for measurement of pulse voltages listed in IEC 60060-2 may be used for the purposes.

The pulse current may induce appreciable voltages in the pulse voltage measuring circuit, causing significant errors. As a check, it is therefore recommended that the lead which normally joins the voltage divider to the live end of the test object should be disconnected from this point and connected instead to the earthed end of the test object, but maintaining approximately the same loop. Alternatively, the test object may be short-circuited or replaced by a solid metal conductor. The voltage measured under any of these conditions, when the generator is discharged, should be negligible in comparison with the voltage across the test object, at least during the part of the pulse which is of importance for evaluating the test results.

NOTE The short-circuit check may be made at a reduced current.

4.8 Capacitance

The varistors shall be placed in corrosion-resistant clamps by their usual means. A preferred means of mounting is given in Annex A for measurements in air and when self-heating may occur. The method in Annex A shall be used in case of dispute.

NOTE 1 Properties of varistors depend on the frequency, arising from their capacitance. Account should be taken of this factor.

NOTE 2 Measurement of capacitance should be made on specimens which have been allowed to recover for at least 48 h after any other electrical test.

4.8.1 The measurements are made in normal conditions, at a frequency of 1 kHz and, unless otherwise prescribed in the detail specification, at a signal level ≤ 1 V r.m.s. with no d.c. bias.

4.8.2 The capacitance shall comply with the value given in the detail specification taking the tolerance into account.

4.9 **Voltage proof** (for insulated varistors only)

The test shall be conducted using one of the following three mounting methods, as prescribed in the detail specification.

4.9.1 V-block method

The varistor shall be clamped in the trough of a 90° metallic V-block of such size that the varistor body does not extend beyond the extremities of the block. The clamping force shall be such as to guarantee adequate contact between the varistor and the block. The clamping force is to be chosen in such a way that no destruction or damage to the varistor occurs. The varistor shall be positioned in accordance with the following.

– For cylindrical varistors: the varistor shall be positioned in the block so that the termination furthest from the axis of the varistor is nearest to one of the faces of the block.
– For rectangular varistors: the varistor shall be positioned in the block so that the termination nearest to the edge of the varistor is nearest to one of the faces of the block.

For cylindrical and rectangular varistors with axial leads: any out-of-centre positioning of the point of emergence of the terminations from the body shall be ignored.

4.9.2 Metal ball method

The uninsulated parts of the varistor shall be enclosed in an insulating material having a very high insulation value.

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The complete varistor shall be placed in a container holding 1,6 mm ± 0,2 mm diameter metal balls such that only the terminations of the varistor are protruding. An electrode shall be inserted between the metal balls.

4.9.3 Foil method

A metal foil shall be wrapped closely around the body of the varistor.

For varistors not having axial terminations, a space of 1 to 1,5 mm shall be left between the edge of the foil and each termination.

For varistors having axial terminations, the foil shall be wrapped around the whole body of the varistor protruding by at least 5 mm from each end, provided that the minimum space of 1 mm between the foil and the termination can be maintained. The ends of the foil shall not be folded over the ends of the varistor.

The applied voltage shall be that specified in the applicable safety document. In the absence of a safety document the applied voltage shall be as follows.

An alternating voltage with a frequency of 40 Hz to 60 Hz and with a peak value of 1,4 times the isolation voltage specified in the detail specification, shall be applied for 60 s ± 5 s (with a peak value of 1,4 times) between all terminations of varistor connected together as one pole and the metallic balls, the metal foil or the V-block as the other pole.

The voltage shall be applied gradually at a rate of approximately 100 V/s. The test time may be reduced to 1 s provided the test voltage is increased by 20 %.

There shall be no breakdown or flashover.

4.10 Insulation resistance (for insulated varistors only)

4.10.1 Test procedure

The test shall be performed using one of the methods specified in 4.9, as prescribed in the detail specification.

4.10.2 Measurement and requirements

The insulation resistance shall be measured with a direct voltage of 100 V ± 15 V (for U_{ISO} <500 V) or 500 V ± 50 V (for U_{ISO} >500 V) between both terminations of the varistor connected together as one pole and the metallic balls, metal foil or V-block as the other pole.

The voltage shall be applied for 1 min, or for such shorter time as is necessary to obtain a stable reading, the insulation resistance being read at the end of that period.

The voltage shall be applied for 1 min or for such shorter time as is necessary to obtain a stable reading; the insulation resistance shall be read at the end of that period.

When varistors are measured as specified, the insulation resistance shall be not less than the appropriate figure specified in the detail specification.

There shall be no breakdown or flashover.

The insulation resistance shall be not less than that prescribed in the detail specification.

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4.11 Robustness of terminations

4.11.1 General

The varistors shall be subjected to Tests Ua1, Ub, Uc and Ud of IEC 60068-2-21 as applicable.

For metal oxide varistors the voltage at specified current shall be measured as specified in 4.5.

4.11.2 Test Ua_1 – Tensile

The force applied shall be

– for terminations other than wire terminations: 20 N;

– for wire terminations, see Table 3.

Table 3 – Force for wire terminations

Nominal cross sectional area mm²	Corresponding diameter for circular section wires mm	Force N
$S \leq 0{,}05$	$d \leq 0{,}25$	1
$0{,}05 < S \leq 0{,}07$	$0{,}25 < d \leq 0{,}3$	2,5
$0{,}07 < S \leq 0{,}2$	$0{,}3 < d \leq 0{,}5$	5
$0{,}2 < S \leq 0{,}5$	$0{,}5 < d \leq 0{,}8$	10
$0{,}5 < S \leq 1{,}2$	$0{,}8 < d \leq 1{,}25$	20
$1{,}2 < S$	$1{,}25 < d$	40

4.11.3 Test Ub – Bending (half of the number of terminations)

Method 1 Two consecutive bends shall be applied in each direction. This test shall not apply if in the detail specification the terminations are described as rigid.

4.11.4 Test Uc – Torsion (other half of the number of terminations)

Method 1, severity 2 (two successive rotations of 180°) shall be used.

This test shall not apply if, in the detail specification, the terminations are described as rigid, and to components with unidirectional terminations designed for printed wiring applications.

4.11.5 Test Ud – Torque (for terminations with threaded studs or screws and for integral mounting devices)

Table 4 – Torque

Nominal thread diameter mm		2,6	3	3,5	4	5	6
Torque (Nm)	Severity 1	0,4	0,5	0,8	1,2	2,0	2,5
	Severity 2	0,2	0,25	0,4	0,6	1,0	1,25

4.11.6 Visual examination

After recovery, the varistors shall be visually examined. There shall be no visible damage.

4.11.7 Final measurement

For silicon carbide varistors, the leakage current shall be measured as prescribed in 4.5, and the value shall not exceed that prescribed in the detail specification.

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For metal oxide varistors the voltage at specified current shall be measured as prescribed in 4.4, and the change from the initially measured value shall not exceed the limits prescribed in the detail specification.

4.12 Resistance to soldering heat

4.12.1 Preconditioning

When prescribed by the relevant specification the thermistors shall be dried using the method of 4.3.

The thermistors shall be measured as prescribed in the relevant specification.

4.12.2 Test procedure

Unless otherwise stated in the relevant specification, one of the following tests as set out in the same specification shall be applied.

The test conditions shall be defined in the relevant specification.

a) For all thermistors except those of item b) and c) below:

   IEC 60068-2-20, Test Tb, method 1 (solder bath).

b) For thermistors not designed for use in printed boards, but with connections intended for soldering as indicated by the detail specification:

   1) IEC 60068-2-20, Test Tb, method 1 (solder bath)

   2) IEC 60068-2-20, Test Tb, method 2 (soldering iron).

c) For surface mounting thermistors:

   IEC 60068-2-58, reflow or solder bath method

4.12.3 Recovery

The period of recovery shall, unless otherwise specified by the detail specification, be not less than 1 h nor more than 2 h, except for surface mount thermistors, for which the period of recovery shall be 24 h ± 2 h.

4.12.4 Final inspection, measurement and requirements

For all thermistors, except surface mount thermistors, the following shall apply.

– When the test has been carried out the thermistors shall be visually examined.
– There shall be no visible damage and the marking shall be legible.
– The thermistors shall then be measured as prescribed in the relevant specification.

Surface mount thermistors shall be visually examined and measured and shall meet the requirements as prescribed in the relevant specification.

4.13 Solderability

NOTE Not applicable to those terminations which the detail specification describes as not designed for soldering.

The relevant specification should prescribe whether ageing is to be applied. If accelerated ageing is required, one of the ageing procedures given in IEC 60068-2-20 should be applied.

Unless otherwise stated in the relevant specification, the test should be carried out with non-activated flux.

4.13.1 Test procedure

Unless otherwise stated in the relevant specification, one of the following tests as set out in the same specification shall be applied.

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The test conditions shall be defined in the relevant specification.

a) For all thermistors except those of item b) and c) below:

   1) IEC 60068-2-20, Test Ta, method 1 (solder bath).
      Depth of immersion (from the seating plane or component body):
      2,0 mm, using a thermal insulating screen of 1,5 mm ± 0,5 mm thickness;
   2) IEC 60068-2-20, Test Ta, method 2 (soldering iron).
   3) IEC 60068-2-54

b) For thermistors not designed for use in printed boards, but with connections intended for soldering as indicated by the detail specification:

   1) IEC 60068-2-20, Test Ta, method 1 (solder bath).
      Depth of immersion (from the seating plane or component body): 3,5mm.
   2) IEC 60068-2-20, Test Ta, method 2 (soldering iron).

c) For surface mounting thermistors:

   1) IEC 60068-2-58, reflow or solder bath method
   2) IEC 60068-2-69, solder bath or solder globule method

4.13.2 Final inspection, measurements and requirements

The terminations shall be examined for good tinning as evidenced by free flowing of the solder with wetting of the terminations.

The thermistors shall meet the requirements as prescribed in the relevant specification.

4.14 Rapid change of temperature

4.14.1 Initial measurement

For metal oxide varistors the voltage at specified current shall be measured as specified in 4.5.

4.14.2 Test procedure

The varistors shall be subjected to Test Na of IEC 60068-2-14 for five cycles. The duration of the exposure at each of the extremes of temperature shall be 30 min.

The varistors shall then remain under standard atmospheric conditions for recovery for not less than 1 h nor more than 2 h.

4.14.3 Final inspection, measurement and requirements

After recovery, the varistors shall be visually examined. There shall be no visible damage and the marking shall be legible.

For silicon carbide varistors, the leakage current shall be measured as prescribed in 4.5, and the value shall not exceed that prescribed in the detail specification.

For metal oxide varistors the voltage at specified current shall be measured as prescribed in 4.5, and the change from the initially measured value shall not exceed the limits prescribed in the detail specification.

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4.15 Bump

4.15.1 Initial measurement

For metal oxide varistors the voltage at specified current shall be measured as specified in 4.5.

4.15.2 Test procedure

The varistor shall be mounted as indicated in the relevant specification.

The varistors shall be subjected to Test Eb of IEC 60068-2-29 using the degree of severity prescribed in the detail specification.

4.15.3 Final inspection, measurement and requirements

After recovery, the varistors shall be visually examined. There shall be no visible damage.

For silicon carbide varistors, the leakage current shall be measured as prescribed in 4.5 and the value shall not exceed that prescribed in the detail specification.

For metal oxide varistors the voltage at specified current shall be measured as prescribed in 4.5 and the change from the initially measured value shall not exceed the limits prescribed in the detail specification.

4.16 Shock

4.16.1 Initial measurement

For metal oxide varistors the voltage at specified current shall be measured as specified in 4.5.

4.16.2 Test procedure

The varistor shall be mounted as indicated in the relevant specification.

The varistors shall be subjected to Test Ea of IEC 60068-2-27 using the degree of severity prescribed in the detail specification.

4.16.3 Final inspection, measurement and requirements

After recovery, the varistors shall be visually examined. There shall be no visible damage.

For silicon carbide varistors, the leakage current shall be measured as prescribed in 4.4, and the value shall not exceed that prescribed in the detail specification.

For metal oxide varistors the voltage at specified current shall be measured as prescribed in 4.5, and the change from the initially measured value shall not exceed the limits prescribed in the detail specification.

4.17 Vibration

4.17.1 Initial measurement

For metal oxide varistors the voltage at specified current shall be measured as specified in 4.5.

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4.17.2 Test procedure

The varistor shall be mounted as indicated in the relevant specification.

Unless otherwise prescribed by the detail specification the varistors shall be subjected to Method B4 of Test Fc of IEC 60068-2-6 using the degree of severity prescribed in the detail specification.

4.17.3 Final inspection, measurement and requirements

After recovery, the varistor shall be visually examined. There shall be no visible damage.

For silicon carbide varistors, the leakage current shall be measured as prescribed in 4.5, and the value shall not exceed that prescribed in the detail specification.

For metal oxide varistors the voltage at specified current shall be measured as prescribed in 4.5, and the change from the initially measured value shall not exceed the limits prescribed in the detail specification.

4.18 Climatic sequence

In the climatic sequence, an interval of maximum 3 days is permitted between any of the tests, except that the cold test shall be applied immediately after the recovery period specified for the first cycle of the damp heat, cyclic, Test Db.

4.18.1 Initial measurement

For metal oxide varistors the voltage at specified current shall be measured as specified in 4.5.

4.18.2 Dry heat

The varistors shall be subjected to Test Ba of IEC 60068-2-2 at the upper category temperature for a duration of 16 h.

4.18.3 Damp heat, cyclic, Test Db, first cycle

The varistors shall be subjected to Test Db of IEC 60068-2-30 for one cycle of 24 h, using a temperature of 55°C (Severity b), Variant 1.

4.18.4 Cold

The varistors shall be subjected to Test Aa of IEC 60068-2-1 at the lower category temperature for a duration of 2 h.

4.18.5 Low air pressure

a) The varistors shall be subjected to Test M of IEC 60068-2-13 using the degree of severity prescribed in the detail specification.

b) The test shall be carried out at a temperature of between 15 °C and 35 °C. The duration of the test shall be 1 h.

4.18.6 Damp heat, cyclic, Test Db, remaining cycles

The varistors shall be subjected to Test Db of IEC 60068-2-30 for the following cycles of 24 h as indicated in Table 5, at a temperature of 55 °C (Severity b), Variant 1.

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Table 5 – Number of cycles

Categories	Number of cycles
- / - / 56	5
- / - / 21	1
- / - / 10	1
- / - / 04	0
- / - / 00	0

The varistors shall remain under standard atmospheric conditions for recovery for not less than 1 h nor more than 2 h.

4.18.7 Final inspection, measurement and requirements

After recovery the varistors shall be visually examined. There shall be no visible damage and the marking shall be legible.

For silicon carbide varistors, the leakage current shall be measured as prescribed in 4.5, and the value shall not exceed that prescribed in the detail specification.

For metal oxide varistors the voltage at specified current shall be measured as prescribed in 4.5, and the change from the initially measured value shall not exceed the limits prescribed in the detail specification.

The insulation resistance shall be not less than that prescribed in the detail specification.

The voltage proof test shall be performed as prescribed in 4.8. There shall be no breakdown or flashover.

4.19 Damp heat, steady state

4.19.1 Initial measurement

For metal oxide varistors the voltage at specified current shall be measured as specified in 4.5.

4.19.2 Test procedure

The varistors shall be subjected to Test Ca of IEC 60068-2-78 using the degree of severity corresponding to the climatic category of the varistor as indicated in the detail specification.

The varistors shall be divided into two groups.

a) The first group shall be subjected to this test without voltage applied.
b) The second group shall be subjected to the test and a d.c. voltage as prescribed in the sectional or in the detail specification shall be applied.

The varistors shall remain under standard atmospheric conditions for recovery for not less than 1 h nor more than 2 h.

4.19.3 Final inspection, measurement and requirements

After recovery, the varistors shall be visually examined. There shall be no visible damage and the marking shall be legible.

For silicon carbide varistors, the leakage current shall be measured as prescribed in 4.5, and the value shall not exceed that prescribed in the detail specification.

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For metal oxide varistors the voltage at specified current shall be measured as prescribed in 4.5, and the change from the initially measured value shall not exceed the limits prescribed in the detail specification.

The insulation resistance shall be not less than that prescribed in the detail specification.

4.20 Fire hazard

The varistors shall be subjected to the needle flame test of IEC 60695-11-5.

The detail specification shall specify the following details:

a) any preconditioning, if required;
b) the number of test specimens, if not three;
c) the position of the specimen;
d) the surface to be tested and the point of application;
e) the underlying layer to be used to evaluate the effect of flaming drops;
f) the level of severity:
   – the duration of application of the test flame (ta);
g) the requirements:
   – the permissible duration and extent of burning, considering the design and the arrangements of the various parts, and shields and barriers inside the equipment;
   – whether the criteria specified are sufficient to check compliance with the safety requirements, or whether further criteria should be introduced;
h) any deterioration of mechanical/electrical properties allowed.

4.21 Endurance at upper category temperature

4.21.1 For metal oxide varistors the voltage at specified current shall be measured as specified in 4.5.

4.21.2 The varistors shall be subjected to an endurance test of 1 000 h ± 24 h at an ambient temperature equal to the upper category temperature specified in the detail specification.

4.21.3 The maximum continuous d.c. or a.c. voltage, as prescribed in the detail specification, and taking account of the derating curve, shall be applied in cycles of 1,5 h on and 0,5 h off throughout the test in accordance with the operating conditions appropriate to the upper category temperature.

The “half-hour-off” periods are included in the total duration specified in 4.20.1.

4.21.4 The varistors shall be held in position by their terminations to suitable clips on a rack of insulating material.

The distance between two adjacent varistors shall be not less than three times the major dimension of their body.

There shall be no undue draught over the varistors. Only natural convection resulting from the hot varistors is allowed.

4.21.5 After approximately 48 h, 500 h and 1 000 h the varistors shall be removed from the chamber and allowed to cool under standard atmospheric conditions for recovery of 4 h ± 0,5 h.

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The removal from the chamber shall take place at the end of a half-hour-off period.

4.21.5.1 After recovery, the varistors shall be visually examined. There shall be no visible damage and the marking shall remain legible.

4.21.5.2 For silicon carbide varistors, the leakage current shall be measured as prescribed in 4.4, and the value shall not exceed that prescribed in the detail specification.

For metal oxide varistors the voltage at specified current shall be measured as prescribed in 4.4, and the change from the initially measured value shall not exceed the limits prescribed in the detail specification.

4.21.6 After intermediate measurements, the varistors shall be returned to the test chamber. The interval between the removal of any varistor from the chamber and its return to the conditions of test shall not exceed 12 h.

4.21.7 After 1 000 h the varistor shall additionally be subjected to the following tests.

4.21.7.1 The voltage at class current shall be measured and the value shall not exceed that prescribed in the detail specification.

4.21.7.2 The insulation resistance shall be measured and the value shall be not less than that prescribed in the detail specification.

4.22 Solvent resistance of marking

4.22.1 Test procedure

The components shall be subjected to Test XA of IEC 60068-2-45 with the following details.

a) Solvent to be used: See 3.1.1 of IEC 60068-2-45.
b) Solvent temperature: 23 °C ± 5 °C.
c) Conditioning: Method 1 (with rubbing).
d) Rubbing material: Cotton wool.
e) Recovery time: Not applicable, unless otherwise stated in the detail specification.

4.22.2 Requirements

After the test the marking shall be legible.

4.23 Component solvent resistance

4.23.1 Initial measurements

The measurements prescribed in the relevant specification shall be made.

4.23.2 Test procedure

The components shall be subjected to Test XA of IEC 60068-2-45 with the following details.

Solvent to be used: See 3.1.1 of IEC 60068-2-45.

Solvent temperature: 23 °C ± 5 °C, unless otherwise specified in the detail specification.

Conditioning: Method 2 (without rubbing).

Recovery time: 48 h, unless otherwise stated in the detail specification.

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4.23.3 Measurement and requirements

The measurements prescribed in the relevant specification shall be made and the specified requirements shall be met.

4.24 Mounting (for surface mount varistors only)

4.24.1 An example of a mounting for surface mount varistors is shown in Figure A.4.

4.24.2 Surface mount varistors shall be mounted on a suitable substrate, the method of mounting depending on the varistor construction. The substrate material shall normally be a 1,6 mm thick epoxide woven glass fabric laminated printed board (as defined in IEC 61249-2-7, IEC-EP-GC-CU) or a 0,635 mm alumina substrate and shall not affect the result of any test or measurement. The detail specification shall indicate which material is to be used for the electrical measurements.

The substrate shall have metallized land areas of proper spacing to permit mounting of surface mount varistors and shall provide electrical connection to the surface mount varistor terminals. The details shall be specified in the detail specification.

If another method of mounting applies, the method should be clearly described in the detail specification.

4.24.3 When the detail specification specifies wave soldering, suitable glue, details of which may be specified in the detail specification, shall be used to fasten the component to the substrate before soldering is performed.

Small dots of the glue shall be applied between the conductors of the substrate by means of a suitable device securing repeatable results.

The surface mount varistors shall be placed on the dots using tweezers. To ensure that no glue is applied to the conductors, the surface mount varistors shall not be moved about.

The substrate with the surface mount varistors shall be heat-treated in an oven at 100 °C for 15 min.

The substrate shall be soldered in a wave soldering apparatus. The apparatus shall be adjusted to have a pre-heating temperature of 80 °C to 130 °C, a solder bath at 260 °C ± 5 °C and a soldering time of 5 s ± 0,5 s.

The soldering operation shall be repeated once more (two cycles in total).

The substrate shall be cleaned for 3 min in a suitable solvent (see 3.1.2 of IEC 60068-2-45).

4.24.4 When the detail specification specifies reflow soldering, the following mounting procedure applies.

a) The solder used in preform or paste form shall be silver bearing (2 % minimum) eutectic Sn/Pb solder together with a non-activated flux as stated in IEC 60068-2-20. Alternative solders such as 60/40 or 63/37 may be used on surface mount varistors whose construction includes solder leach barriers. The Pb-free solder used in preform or paste form shall be Sn96,5-Ag3,0-Cu0,5 or derivative solder together with a flux as stated in IEC 60068-2-58.

b) The surface mount varistor shall then be placed across the metallized land areas of the test substrate so as to make contact between varistor and substrate land areas.

c) The substrate shall then be placed in or on a suitable heating system (molten solder, hot plate, tunnel oven, etc.). The temperature of the unit shall be maintained between 215 °C

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and 260 °C, until the solder melts and reflows forming a homogeneous solder bond, but for not longer than 10 s.

NOTE 1 Flux should be removed by a suitable solvent (see 3.1.2 of IEC 60068-2-45). All subsequent handling should be such as to avoid contamination. Care should be taken to maintain cleanliness in test chambers and during post test measurements.

NOTE 2 The detail specification may require a more restricted temperature range.

NOTE 3 If vapour phase soldering is applied, the same method may be used with the temperatures adapted.

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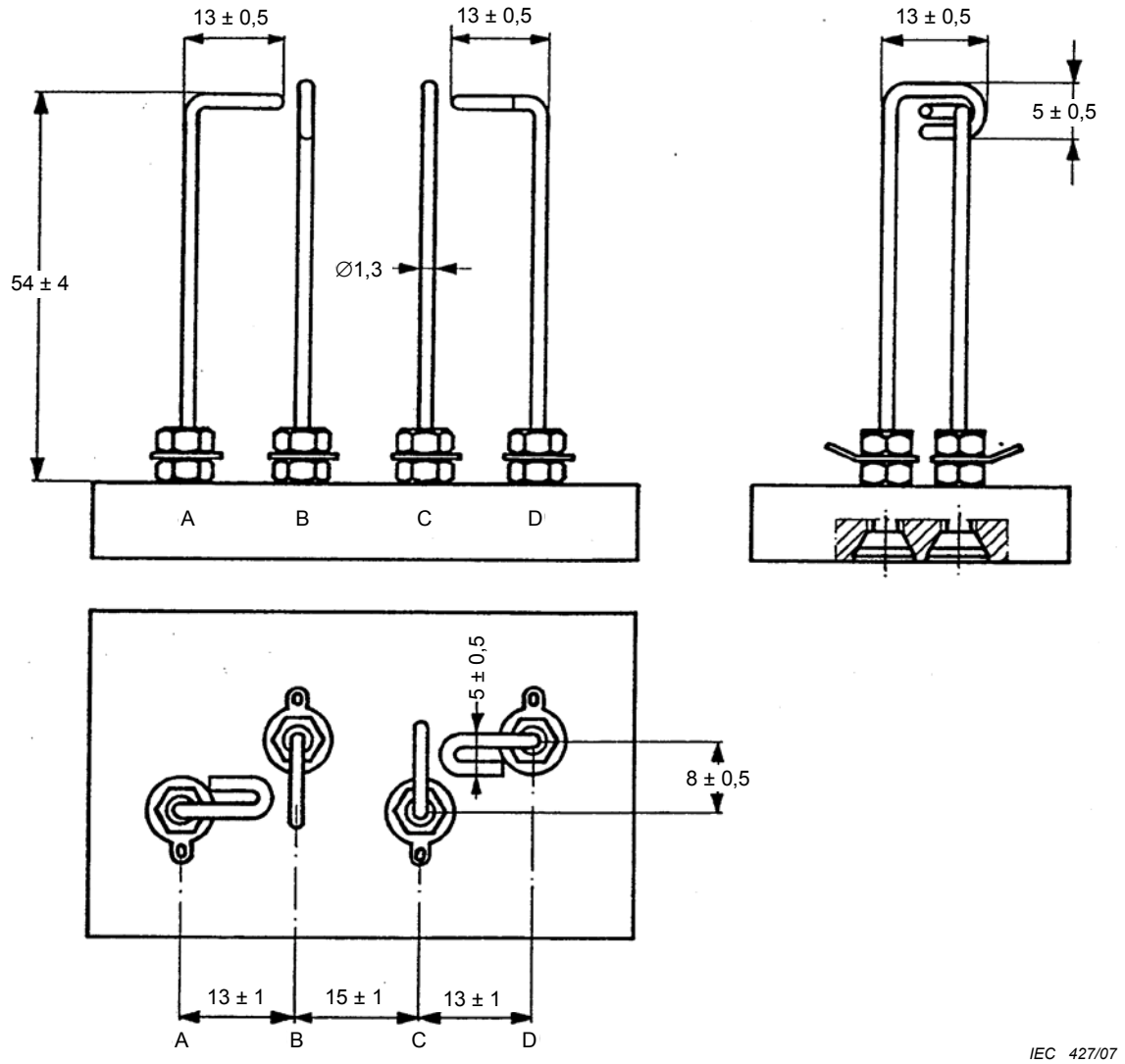
Annex A
(normative)

Mounting for measurements of varistors

Varistors with leads shall be connected (but not soldered) to phosphor-bronze wires of 1,3 mm ± 10 % diameter, mounted on a base of insulation material, as shown below.

Dimensions in millimetres



NOTE Unless otherwise specified in the detail specification, the components should be connected at a distance of 6 mm ± 1 mm from the body.

Figure A.1 – Mounting methods for measurements

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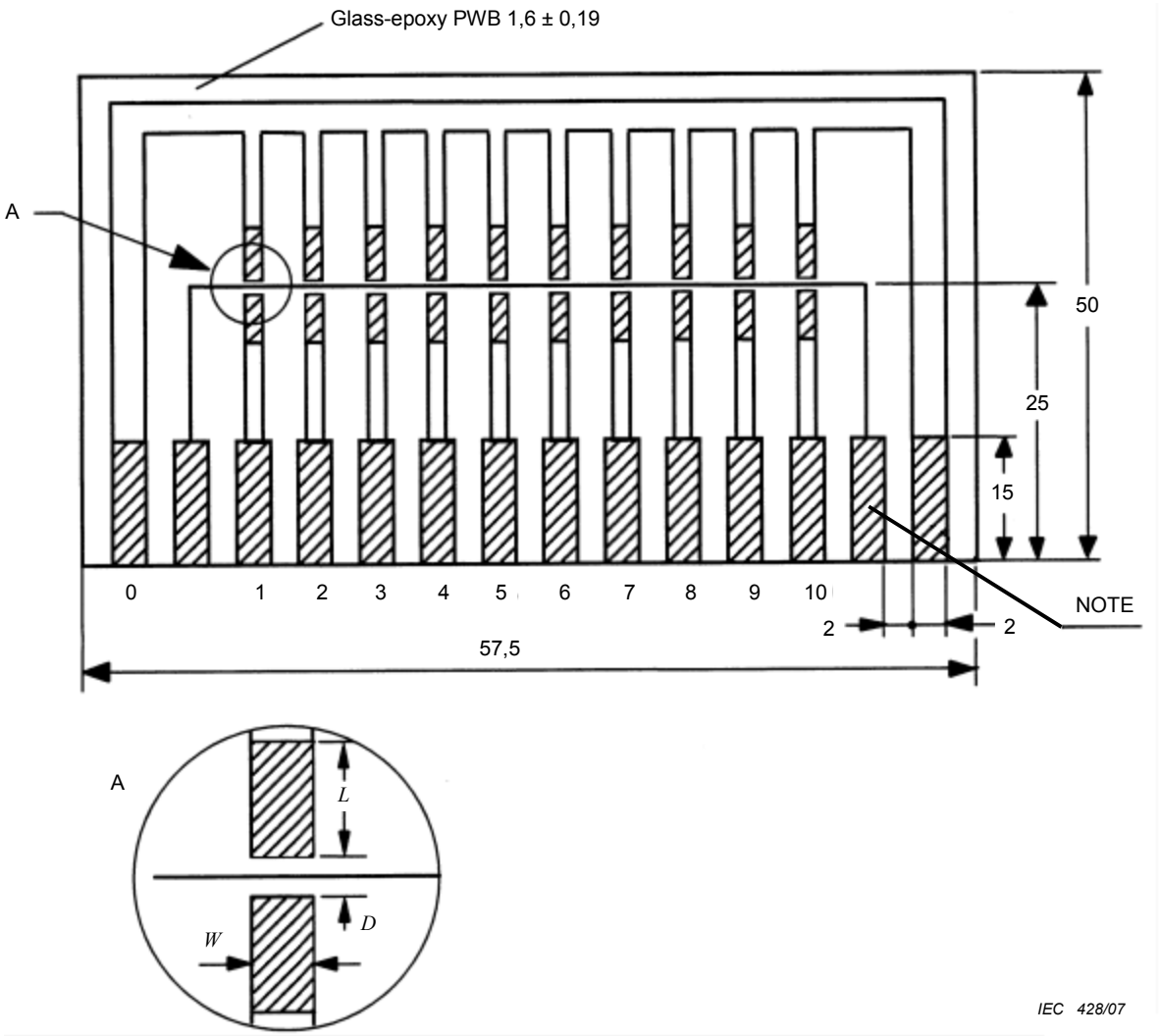

Dimensions in millimetres

NOTE This conductor may be omitted or used as a guard electrode

Figure A.2 – Mounting method for measurements of surface mount varistors

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Annex B
(normative)

Interpretation of sampling plans and procedures as described in IEC 60410 for use within the IEC quality assessment system for electronic components

When using IEC 60410 for inspection by attributes the following interpretations of the clauses and subclauses indicated below apply for the purpose of this standard.

1.1 The responsible authority is the National Authorized Institution implementing the Basic Rules and Rules of Procedure.

1.5 The unit of product is the electronic component defined in a detail specification.

2 Only the following definitions from this clause are required:

– a defect is any nonconformance of the unit of product to specified requirements;

– a defective is a unit of product which contains one or more defects.

3.1 The extent of nonconformance of a product shall be expressed in terms of per cent defective.

3.3 Not applicable.

4.5 The responsible authority is the IEC Technical Committee drafting the blank detail specification which forms part of the generic or sectional specification.

5.4 The responsible authority is the Chief Inspector, acting in accordance with the procedures prescribed in the document describing the inspection department of the approved manufacturer and approved by the National Supervising Inspectorate.

6.2 The responsible authority is the Chief Inspector.

6.3 Not applicable.

6.4 The responsible authority is the Chief Inspector.

8.1 Normal inspection shall always be used at the start of inspection.

8.3.3(d) The responsible authority is the Chief Inspector.

8.4 The responsible authority in the National Supervising Inspectorate.

9.2 The responsible authority is the IEC Technical Committee drafting the blank detail specification which forms part of the generic or sectional specification.

9.4 (Fourth sentence only). Not applicable. (Fifth sentence only). The responsible authority is the Chief Inspector.

10.2 Not applicable.

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Annex C
(normative)

Rules for the preparation of detail specifications for capacitors and resistors for electronic equipment

1 The drafting of a complete detail specification by IEC technical committee 40, if required, shall begin only when all the following conditions have been met.

   a) The generic specification has been approved.

   b) The sectional specification, when appropriate, has been circulated for approval under the Six Months' Rule.

   c) The associated blank detail specification has been circulated for approval under the Six Months' Rule.

   d) There is evidence that at least three National Committees have formally approved as their own national standard, specifications covering a component of closely similar performance.

      Where a National Committee formally asserts that substantial or significant use is made within its country of a part described by some other national standard, this assertion may count towards the foregoing requirement.

2 Detail specifications prepared under the responsibility of technical committee 40 shall use the standard or preferred values, ratings and characteristics and severities for environmental tests, etc., which are given in the appropriate generic or sectional specifications.

   An exception to this rule may only be granted for a specific detail specification when agreed by technical committee 40.

3 The detail specification should not be circulated under the Six Months' Rule until the sectional and blank detail specifications have been approved for publication.

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