

INTERNATIONAL STANDARD

IEC
60393-6

First edition
2003-05

**Potentiometers for use
in electronic equipment –**

**Part 6:
Sectional specification:
Surface mount preset potentiometers**



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Part 6: Sectional specification: Surface mount preset potentiometers

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CONTENTS

FOREWORD	3
1 General	4
1.1 Scope	4
1.2 Object	4
1.3 Normative references	4
1.4 Information to be given in a Detail Specification	5
2 Preferred ratings, characteristics and test severities	9
2.1 Preferred characteristics	9
2.2 Preferred values of ratings	14
2.3 Preferred test severities	16
3 Quality assessment procedures	17
3.1 Structurally similar components	17
3.2 Qualification approval	17
3.3 Quality conformance inspection	25
3.4 Delayed delivery	26
Figure 1 – Suitable substrate for mechanical and electrical tests (may not be suitable for impedance measurements)	7
Figure 2 – Suitable substrate for electrical tests	8
Figure 3 – Rated dissipation curve	15
Figure 4 – Rated dissipation curve with larger area of operation	15
Table 1 – Temperature coefficients and temperature characteristics of resistance	10
Table 2 – Limits for change in resistance and output ratio	11
Table 3 – Fixed sample size test schedule for qualification approval – Assessment level E	19
Table 4 – Assessment level corresponding to inspection subgroup	25
Table 5 – Assessment level corresponding to inspection subgroup	26

INTERNATIONAL ELECTROTECHNICAL COMMISSION

POTENTIOMETERS FOR USE IN ELECTRONIC EQUIPMENT –**Part 6: Sectional specification:
Surface mount preset potentiometers**

FOREWORD

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- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical Specifications, technical reports or guides and they are accepted by the National Committees in that sense.
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International Standard IEC 60393-6 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

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

FDIS	Report on voting
40/1288/FDIS	40/1324/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.

This Sectional Specification is to be used in conjunction with IEC 60393-1:1989.

The committee has decided that the contents of this publication will remain unchanged until 2008. 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.

POTENTIOMETERS FOR USE IN ELECTRONIC EQUIPMENT –

Part 6: Sectional specification: Surface mount preset potentiometers

1 General

1.1 Scope

This International Standard is applicable to surface mount preset potentiometers for use in electronic equipment.

1.2 Object

The object of this standard is to prescribe preferred ratings and characteristics and to select the appropriate quality assessment procedures, tests and measuring methods from IEC 60393-1 and to give general performance requirements for this type of potentiometer.

Test severities and requirements prescribed in Detail Specifications referring to this Sectional Specification shall be of equal or higher performance level, lower performance levels are not permitted.

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 60063:1963, *Preferred number series for resistors and capacitors*

Amendment 1 (1967)

Amendment 2 (1977)

IEC 60068-1, *Environmental testing. Part 1: General and guidance*

IEC 60068-2-20, *Environmental testing. Part 2: Tests. Test T: Soldering*

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

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

IEC 60068-2-58, *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 60393-1:1989, *Potentiometers for use in electronic equipment – Part 1: Generic Specification*

Amendment 1 (1992)

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

IEC QC 001001:2000, *IEC Quality Assessment System for Electronic Components (IECQ) – Basic rules*

IEC QC 001002-3:1998, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of procedure – Part 3: Approval procedures*

1.4 Information to be given in a Detail Specification

Detail Specifications shall be derived from the relevant Blank Detail Specification.

Detail Specifications shall not specify requirements inferior to those of the generic, sectional or Blank Detail Specification.

When more severe requirements are included, they shall be listed in 1.8 of the Detail Specification and indicated in the test schedules, for example by an asterisk.

NOTE The information given in 1.4.1 and 1.4.3 may, for convenience, be presented in tabular form.

The following information shall be given in each Detail Specification and the values quoted shall preferably be selected from those given in the appropriate Clause of this Sectional Specification.

1.4.1 Outline drawing and dimensions

The Detail Specification shall incorporate an illustration of the surface mount preset potentiometer as aid to easy recognition and for comparison of the surface mount potentiometer with others.

Dimensions and their associated tolerances, which affect interchangeability and mounting, shall be given in the Detail Specification. All dimensions shall be stated in millimetres.

Normally the numerical values shall be given for the length, width and thickness of the body.

Where space is insufficient to show the detail dimensions required for inspection purposes, such dimensions shall appear on the drawing forming an annex to the Detail Specification.

Recommended land patterns shall be given in Detail Specification.

When the outline drawing is other than described above, the Detail Specification shall state such dimensional information as will adequately describe the surface mount potentiometer.

1.4.2 Mounting

The Detail Specification shall give guidance on methods of mounting for normal use.

Mounting for test and measurement purposes (when required) shall be in accordance with the following Subclauses¹, unless otherwise specified.

1.4.2.1 Surface mount potentiometers shall be mounted on a suitable substrate; the method of mounting will depend on the potentiometer construction. The Detail Specification shall indicate which material is to be used for electrical measurements.

The substrate shall have metallized land areas of proper spacing to permit mounting of surface mount potentiometers, and it shall provide electrical connection to the surface mount potentiometer terminals. The details shall be specified in the Detail Specification.

¹ The text of 1.4.2 and its Subclauses will be integrated in a future edition of IEC 60393-1.

Examples of test substrates for mechanical and electrical tests are shown in Figures 1 and 2 respectively. If another mounting method applies, the method should be clearly described in the Detail Specification.

1.4.2.2 When the Detail Specification specifies wave soldering, a 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 glue shall be applied between the conductors of the substrate by means of a suitable device securing repeatable results.

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

The substrate with the surface mount potentiometers 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 100 °C, a solder bath at 260 °C $\pm$ 5 °C, and a soldering time of 5 s $\pm$ 0,5 s.

The soldering operation shall be repeated a second time (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).

1.4.2.3 When the Detail Specification specifies reflow soldering, the following mounting procedure applies:

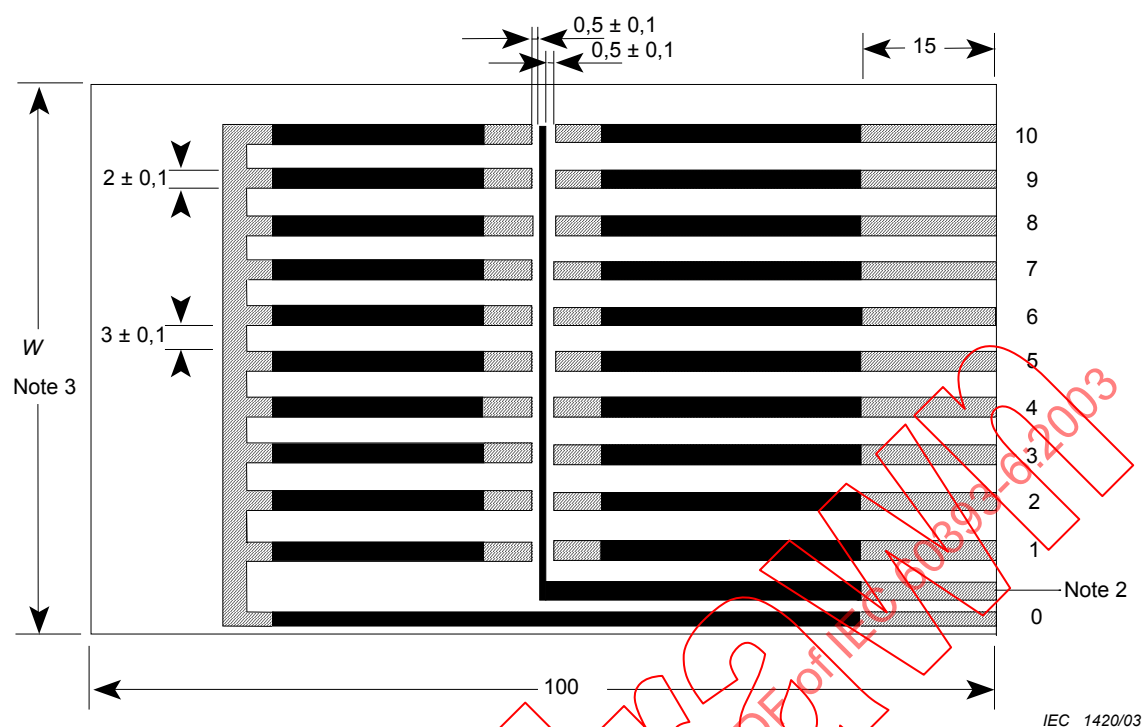
- a) The solder used, in preform or paste form, shall be silver bearing (2 % minimum) eutectic Sn/Pb solder together with a non-activated flux, as stated in test T of IEC 60068-2-20. Alternative solders, such as 60/40 or 63/37 may be used on surface mounts whose construction includes solder leach barriers.
- b) The surface mount potentiometer shall then be placed across the metallized land areas of the test substrate so as to make contact between surface mount 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 and 260 °C, until the solder melts and reflows forming a homogeneous solder bond, but for not longer than 10 s.

NOTE 1 The flux is removed by a suitable solvent (see 3.1.2 of IEC 60068-2-45). All subsequent handling is such as to avoid contamination. Care is 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.

Dimensions in millimetres.

**Key**

Solderable areas.



Areas which shall not be solderable (covered with non-solderable lacquer).

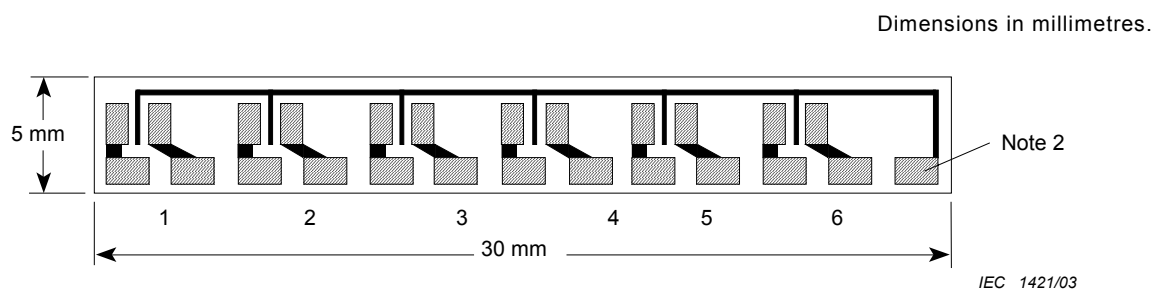
Dimensions not given should be chosen according to the design and size of the specimens to be tested.

NOTE 1 Material: Epoxide woven glass.
Thickness: 1,6 mm $\pm$ 0,1 mm.

NOTE 2 This conductor may be omitted or used as a guard electrode.

NOTE 3 Dimension *W* is dependent on the design of the test equipment.

**Figure 1 – Suitable substrate for mechanical and electrical tests
(may not be suitable for impedance measurements)**



Key



Solderable areas.



Areas which shall not be solderable (covered with non-solderable lacquer).

Dimensions not given should be chosen according to the design and size of the specimens to be tested.

NOTE 1 Material: 90 % to 98 % alumina.
Thickness: 0,635 mm $\pm$ 0,05 mm.

NOTE 2 This conductor may be omitted or used as a guard electrode.

Figure 2 – Suitable substrate for electrical tests

1.4.3 Style (See 2.2.3 of IEC 60393-1)

The style shall be presented by a double letter code for example AB, which is arbitrarily chosen for each Detail Specification.

The style designation therefore has no meaning unless the number of the Detail Specification is also given.

1.4.4 Resistance law

The resistance law is generally not verified. If required, the Detail Specification shall prescribe the measuring points and the associated limits for the output ratio and shall specify the position of the corresponding tests in the test schedules.

1.4.5 Ratings and characteristics

The ratings and characteristics shall be in accordance with the relevant Clauses of this Sectional Specification together with the following:

1.4.5.1 Rated resistance range

See 2.2.1. The preferred values are those of the E-series of IEC 60063 and/or the 1, 2, 5 series.

NOTE When products approved to the Detail Specification have different ranges, the following statement should be added: "The range of values available in each style is given in the register of approvals".

1.4.5.2 Bump and shock

The bump and shock tests are considered to be alternatives. The Detail Specification shall indicate which test has been selected.

1.4.6 Marking

The Detail Specification shall specify the content of the marking on the surface mount preset potentiometer and on the body.

Surface mount preset potentiometers are generally not marked on the body. If some marking can be applied, the surface mount preset potentiometer shall be clearly marked with the rated resistance and many of the remaining items in 2.4 of IEC 60393-1.

All items shall be marked on the package. Deviations from the above mentioned requirements shall be specifically stated.

2 Preferred ratings, characteristics and test severities

2.1 Preferred characteristics

The values given in the Detail Specification shall preferably be selected from the following:

2.1.1 Preferred climatic categories

The surface mount preset potentiometers covered by this Sectional Specification are classified into climatic categories according to the general rules given in IEC 60068-1.

The lower and upper category temperature and the duration of the damp heat, steady state test shall be chosen from the following:

Lower category temperature: -65°C , -55°C , -40°C and -25°C

Upper category temperature: $+70^{\circ}\text{C}$, $+85^{\circ}\text{C}$, $+100^{\circ}\text{C}$, $+125^{\circ}\text{C}$ and $+155^{\circ}\text{C}$

Duration of the damp heat, steady state test: 4, 10, 21 and 56 days.

The severities for the cold and dry heat tests are the lower and upper category temperatures respectively. Because of the construction of some surface mount preset potentiometers, these temperatures will occur between two of the preferred temperatures given in the IEC 60068-2 series. In this case, the nearest preferred temperature within the actual temperature range of the surface mount preset potentiometer shall be chosen for this severity.

2.1.2 Temperature coefficients and temperature characteristics of resistance

The preferred limits of change in resistance for the temperature characteristic of resistance are given in Table 1.

Each line in the Table gives the preferred temperature coefficient and corresponding temperature characteristics for 20°C to 70°C and limits of change in resistance for the measurement of the temperature characteristic of resistance (see 4.14 of IEC 60393-1) on the basis of the category temperature ranges of 2.1.1 of this Sectional Specification.

Table 1 – Temperature coefficients and temperature characteristics of resistance

Temperature coefficient	Temperature characteristic 20/70 °C	Temperature characteristic of resistance (limits of percentage change in resistance)							
		Reference temperature/ lower category temperature				Reference temperature/ upper category temperature			
10 ⁻⁶ /K	%	+20/-65	+20/-55	+20/-40	+20/-25	+20/+85	+20/+100	+20/+125	+20/+155
±1 000	±5	±8,5	±7,5	±6	±4,5	±6,5	±8	±10,5	±13,5
± 750	±3,75	±6,4	±5,63	±4,5	±3,38	±4,88	±6	±7,88	±10,13
± 500	±2,5	±4,3	±3,75	±3	±2,25	±3,25	±4	±5,25	±6,75
± 250	±1,25	±2,15	±1,88	±1,5	±1,13	±1,62	±2	±2,62	±3,38
± 150	±0,75	±1,3	±1,15	±0,9	±0,68	±0,98	±1,2	±1,6	±2,05
± 100	±0,5	±0,85	±0,75	±0,6	±0,45	±0,65	±0,8	±1,05	±1,35
± 50	±0,25	±0,43	±0,375	±0,3	±0,23	±0,325	±0,4	±0,525	±0,675
± 25	±0,125	±0,215	±0,188	±0,15	±0,113	±0,162	±0,2	±0,262	±0,34

NOTE 1 Potentiometers having an upper category temperature of +85 °C need not be measured between 20 °C and 70 °C.

NOTE 2 If measurements are required at additional temperatures, these shall be specified in the Detail Specification.

2.1.3 Limits for change in resistance and output ratio

For each stability class, the preferred limits for change in resistance and output ratio for each of the tests listed in the heading of Table 2 are as indicated.

Table 2 – Limits for change in resistance and output ratio

Stability class	4.38 Climatic sequence 4.39 Damp heat, steady state 4.40 Mechanical endurance 4.43.2 Electrical endurance at 70 °C 4.43.3 Electrical endurance at upper category temperature	4.34 Change of temperature	2.1.3.1 of this Sectional Specification Shear 2.1.3.2 of this Sectional Specification Substrate bending test 2.1.3.3 of this Sectional Specification Resistance to soldering heat 4.35 Vibration 4.36 Bump 4.37 Shock	4.43.2 Electrical endurance at 70 °C 4.43.3 Electrical endurance at upper category temperature	4.22 Thrust and pull on spindle	4.35 Vibration
	ΔR between terminals a and c		ΔR between terminals a and b	$\Delta \frac{U_{ab}}{U_{ac}}$ (See NOTE 2)		
10	$\pm(10 \% R+0,5 \Omega)$	$\pm(5 \% R+0,1 \Omega)$	$\pm(5 \% R+0,1 \Omega)$	$\pm(15 \% R+0,5 \Omega)$	$\pm 5 \%$	$\pm 7,5 \%$
5	$\pm(5 \% R+0,1 \Omega)$	$\pm(3 \% R+0,1 \Omega)$	$\pm(2 \% R+0,1 \Omega)$	$\pm(7,5 \% R+0,1 \Omega)$	$\pm 2 \%$	$\pm 3 \%$
3	$\pm(3 \% R+0,1 \Omega)$	$\pm(2 \% R+0,1 \Omega)$	$\pm(1 \% R+0,05 \Omega)$	$\pm(5 \% R+0,1 \Omega)$	$\pm 1 \%$	$\pm 2 \%$
2	$\pm(2 \% R+0,1 \Omega)$	$\pm(2 \% R+0,1 \Omega)$	$\pm(1 \% R+0,05 \Omega)$	$\pm(3 \% R+0,1 \Omega)$	$\pm 1 \%$	$\pm 2 \%$
NOTE 1 The clause numbers in the heading of the Table refer to IEC 60393-1, unless otherwise specified.						
NOTE 2 The change in the output voltage ratio $\Delta \frac{U_{ab}}{U_{ac}}$ shall be expressed in percent of the total applied voltage.						

2.1.3.1 Shear (adhesion) test²

2.1.3.1.1 Test conditions: the surface mount potentiometer shall be mounted as described in 1.4.2.

The potentiometer shall be subjected to test Ue₃ of IEC 60068-2-21, under the following condition.

A force of 5 N shall be applied to the surface mount potentiometer body progressively, without shock, and shall be maintained for a period of 10 s ± 1 s.

2.1.3.1.2 Requirements: the surface mount potentiometer shall be visually examined in the mounted state. There shall be no visible damage.

² The text of 2.1.3.1, 2.1.3.2, 2.1.3.3 and 2.1.3.4 and their Subclauses will be integrated in a future edition of IEC 60393-1.

2.1.3.2 Substrate bending test (formerly bond strength of the end face plating)

2.1.3.2.1 The surface mount potentiometer shall be mounted on an epoxide woven glass printed board, as described in 1.4.2.

2.1.3.2.2 The resistance of the surface mount potentiometer shall be measured as specified in 4.6 of IEC 60393-1.

2.1.3.2.3 The potentiometer shall be subjected to test U_{e1} of IEC 60068-2-21 using the conditions as prescribed in the relevant Specification for deflection D and the number of bends.

2.1.3.2.4 The resistance of the surface mount potentiometer shall be measured as specified in 4.6 of IEC 60393-1, with the board in the bent position. The change in resistance compared with that measured in 2.1.3.2.2 shall not exceed the value specified in the Detail Specification.

2.1.3.2.5 The printed board shall be allowed to recover from the bent position and then removed from the test jig.

2.1.3.2.6 Final inspection and requirements: the surface mount potentiometers shall be visually examined and there shall be no visible damage.

2.1.3.3 Resistance to soldering heat

2.1.3.3.1 If drying is called for in the Detail Specification, it shall be stated whether procedure I or procedure II of 4.3 of IEC 60393-1 shall be used.

When the resistance to soldering heat test is to be applied immediately after the solderability test, the drying procedure may be performed prior to the solderability test. The resistance shall then be measured as specified in 4.6 of IEC 60393-1.

2.1.3.3.2 Unless otherwise stated in the relevant Specification, one of the following tests shall be applied, as prescribed by the relevant Specification:

a) for all potentiometers except those of items b) and c) below, apply method 1A of test Tb of IEC 60068-2-20, with the following conditions:

- temperature of the solder bath: $260\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$;
- depth of immersion from the seating plane: $2_{-0,5}^0\text{ mm}$, using a thermal insulating screen of $1,5\text{ mm} \pm 0,5\text{ mm}$ thickness;
- immersion time: 5 s or 10 s, as specified in the Detail Specification.

b) for potentiometers not designed for use in printed boards, as indicated by the Detail Specification, apply method 1B of test Tb of IEC 60068-2-20, with the following conditions:

- temperature of the solder bath: $350\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$;
- depth of immersion from the component body: $3,5_{-0,5}^{+0}\text{ mm}$,
- immersion time: $3,5\text{ s} \pm 0,5\text{ s}$. The whole process of immersion, dwell in the bath and withdrawal shall be completed in not more than 5 s or less than 3,5 s,

or

- method 2: soldering iron of test Tb of IEC 60068-2-20, with the following conditions:
- temperature of the soldering iron: $350\text{ }^{\circ}\text{C}$;
- soldering time: $10\text{ s} \pm 1\text{ s}$.

The size of the soldering iron and the point of application shall be specified in the Detail Specification.

- c) for surface mount potentiometers, apply test Td of IEC 60068-2-58. The relevant Specification shall prescribe the severity and method to be used for the resistance to soldering heat to be consistent with the surface mounting classification³.

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

The resistance shall be measured, as specified in 4.6 of IEC 60393-1, $24 \text{ h} \pm 4 \text{ h}$ (for surface mount potentiometers 1 h to 2 h) after the test, unless it can be demonstrated that stability is reached earlier.

The change of resistance with respect to the value measured in 2.1.3.3.1 shall not exceed the limit prescribed in the relevant Specification.

2.1.3.4 Solderability

2.1.3.4.1 When the solderability test is followed immediately by the resistance to soldering heat test, a drying procedure as prescribed in 4.3 of IEC 60393-1 shall be applied. The Detail Specification shall prescribe whether procedure I or procedure II shall be used.

2.1.3.4.2 All potentiometers except surface mount potentiometers shall be subject to test T of IEC 60068-2-20 using either the solder bath method (method 1) or the soldering iron method (method 2), or the solder globule method (method 3), as prescribed by the relevant Specification.

2.1.3.4.3 When the solder bath method (method 1) is specified, the following requirements apply.

2.1.3.4.3.1

Test conditions

The test shall be carried out under the following conditions.

a) All potentiometers, except those of b) below:

- bath temperature: $235 \text{ }^{\circ}\text{C} \pm 5 \text{ }^{\circ}\text{C}$;
- immersion time: $2 \text{ s} \pm 0,5 \text{ s}$;
- depth of immersion (from the seating plane or component body): $2_{-0,5}^0 \text{ mm}$, using a thermal insulating screen of $1,5 \text{ mm} \pm 0,5 \text{ mm}$ thickness.

b) Potentiometers indicated by the Detail Specification as not being designed for use on printed boards

- bath temperature: $270 \text{ }^{\circ}\text{C} \pm 10 \text{ }^{\circ}\text{C}$;
- immersion time: $2 \text{ s} \pm 0,5 \text{ s}$;
- depth of immersion (from the component body): 6_0^{+1} mm .

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

2.1.3.4.4 When the solder bath method is not applicable, the Detail Specification shall define the test method, test conditions and the requirements.

NOTE When the solder globule method is used, the soldering time is to be included in the requirements.

³ Under consideration.

2.1.3.4.5 Surface mount potentiometers shall be tested in accordance with test Td of IEC 60068-2-58. The relevant Specification shall prescribe the severity and method to be used so that wetting, dewetting or resistance to dissolution or metallization is consistent with the surface mounting classification⁴.

The Detail Specification shall also indicate the specific areas of the specimen to be examined after dewetting.

The surface mount potentiometers shall meet the requirements as prescribed in the relevant Specification.

2.1.4 Total mechanical travel

The preferred values shall be:

- 1) for single turn rotary surface mount preset potentiometers:
the angle shall be specified in the Detail Specification.
- 2) for lead screw actuated surface mount preset potentiometers:
2, 4, 12, 15 and 22 turns.

2.2 Preferred values of ratings

The values given in Detail Specifications shall preferably be selected from the following:

2.2.1 Rated resistance

See 2.3.2 of IEC 60393-1.

2.2.2 Tolerances on rated resistance

$\pm 30\%$; $\pm 25\%$; $\pm 20\%$; $\pm 10\%$ and $\pm 5\%$

2.2.3 Rated dissipation (in the mounted state)

The preferred values of rated dissipation at 70 °C are:

0,05 W; 0,063 W; 0,1 W; 0,125 W; 0,15 W; 0,2 W; 0,25 W; 0,5 W; 0,75 W and 1 W

The Detail Specification shall specify the conditions under which the rated dissipation applies.

The derated values of dissipation at temperatures in excess of 70 °C shall be as indicated by the curve in Figure 3.

⁴ Under consideration.

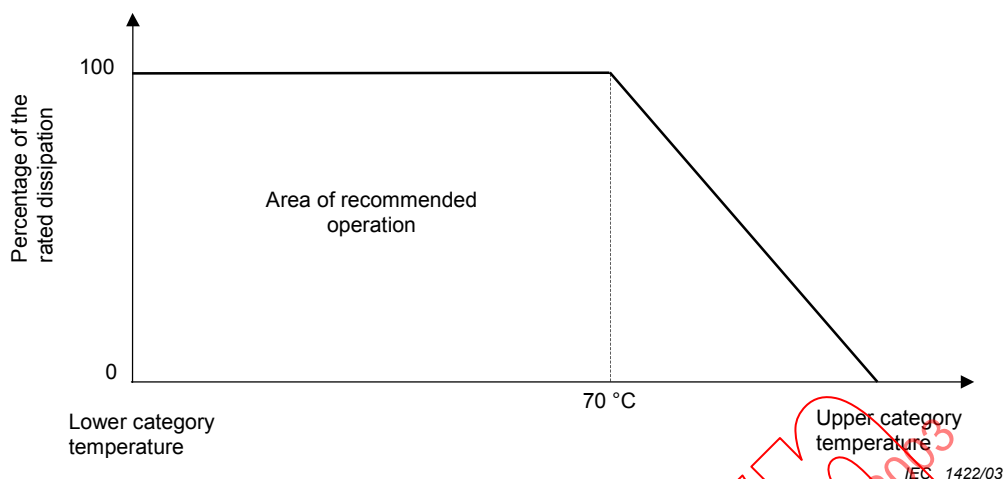


Figure 3 – Rated dissipation curve

A larger area of operation may be given in the Detail Specification, provided it includes all the area given in Figure 3. In this event, the Detail Specification shall state the maximum allowable dissipation at temperatures other than 70 °C. All break points on the curve shall be verified by test.

An example of a derating curve having a larger area of operation is given in Figure 4.

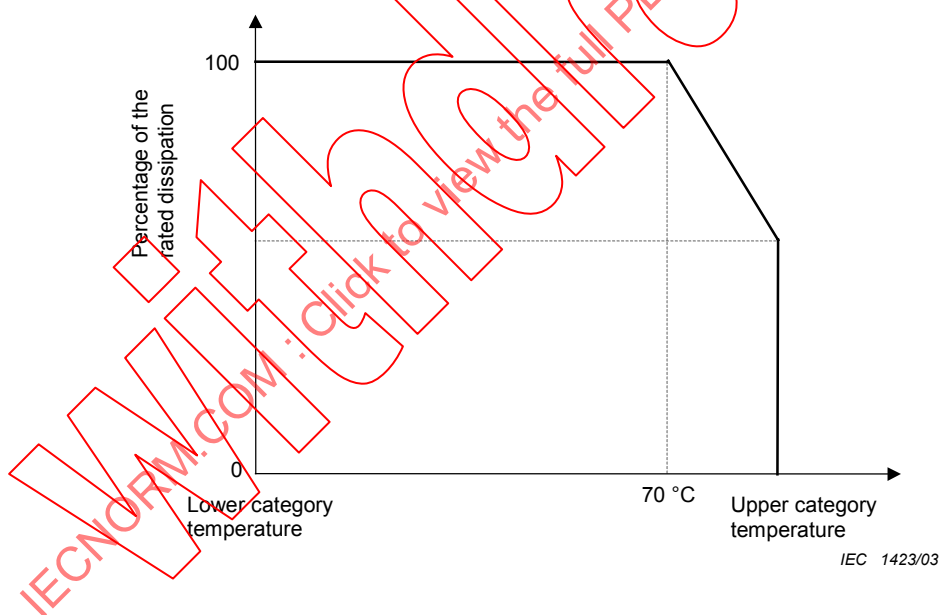


Figure 4 – Rated dissipation curve with larger area of operation

2.2.4 Limiting element voltage

The preferred values of limiting element voltage are:

15 V, 30 V, 50 V, 75 V, 100 V, 125 V, 150 V, 200 V, 250 V and 300 V DC or AC r.m.s.

2.2.5 Insulation voltage

The Detail Specification shall prescribe the value of the insulation voltage, rounded off to the nearest 10 V. The numerical value of the insulation voltage shall be:

Normal air pressure: $\geq 1,42$ times the limiting element voltage.

Low air pressure: at 8 kPa, two-thirds the value at normal air pressure.

2.2.6 Limits for insulation resistance

Unless otherwise specified in the Detail Specification, the insulation resistance shall be not less than 1 G Ω after dry heat tests and 100 M Ω after humidity tests.

2.3 Preferred test severities

Test severities given in the Detail Specification shall preferably be selected from the following:

2.3.1 Drying

Procedure 1 of 4.3 of IEC 60393-1, shall be used.

2.3.2 Vibration

See 4.35 of IEC 60393-1, with the following details:

Frequency range: 10 Hz to 55 Hz, or
10 Hz to 500 Hz, or
10 Hz to 2 000 Hz

Amplitude: 0,75 mm or acceleration 100 m/s² (whichever is the less severe)

Sweep endurance: Total duration: 6 h

The Detail Specification shall prescribe the mounting method to be used (see 1.4.2).

2.3.3 Bump

See 4.36 of IEC 60393-1, with the following details:

Acceleration: 400 m/s²
Number of bumps: 4 000 (total)

The Detail Specification shall prescribe the mounting method to be used (see 1.4.2).

2.3.4 Shock

See 4.37 of IEC 60393-1, with the following details:

Pulse shape: half sine
Acceleration: 500 m/s²
Pulse duration: 11 ms
Severity: 3 successive shocks in each direction per specimen
separate specimens to be used for each direction

The Detail Specification shall prescribe the mounting method to be used (see 1.4.2).

2.3.5 Low air pressure

See 4.38.5 of IEC 60393-1, with the following details:

Air pressure: 8 kPa

2.3.6 Change of temperature

See 4.34 of IEC 60393-1, with the following details:

The duration of the exposure at the extremes of temperature shall be 30 min.

2.3.7 Mounting

See 1.4.2 of this Sectional Specification.

3 Quality assessment procedures

3.1 Structurally similar components

Surface mount preset potentiometers are considered as being structurally similar if they are produced with similar processes and materials, and have the same nominal dimensions but different resistance values and temperature characteristics.

3.2 Qualification approval

The procedures for qualification approval testing are given in 3.4 of IEC 60393-1.

The schedule to be used for qualification approval testing on the basis of lot-by-lot and periodic testing is given in 3.3 of this Sectional Specification. The procedure using a fixed sample size schedule is given in 3.2.1 and 3.2.2.

3.2.1 Qualification approval on the basis of the fixed sample size procedure

The fixed sample size procedure is described in 3.4.2 b) of IEC 60393-1. The sample shall be representative of the range of values for which approval is sought. This may or may not be the complete range covered by the Detail Specification.

The sample shall consist of specimens having the highest and lowest resistance values for which approval is being sought. It should also include the specimens having the critical resistance value, if this is within the range being submitted. When approval is being sought for more than one temperature coefficient of resistance, the sample shall contain specimens representative of the different temperature coefficients. In a similar manner, the sample shall contain a proportion of specimens of the different resistance values having the closest tolerance for which approval is being sought. The proportion of specimens having the different characteristics shall be proposed by the manufacturer's chief inspector and shall be to the satisfaction of the National Supervising Inspectorate (N.S.I.).

Spare specimens are permitted as follows:

- a) One per resistance value and one per each temperature coefficient or temperature characteristic value which may be used to replace the permitted defectives is Group 0.
- b) One per resistance value and one per each temperature coefficient or temperature characteristic value which may be used to replace specimens which are defective because of incidents not attributable to the manufacturer.

When additional groups are introduced into the qualification approval test schedule, the number of specimens required for Group 0 shall be increased by the same number as that required for the additional groups.

3.2.2 Tests

The complete series of tests specified in Table 3 are required for the approval of surface mount preset potentiometers covered by one Detail Specification. The tests of each group shall be carried out in the given order.

The whole sample shall be subjected to the tests of Group 0 and then divided for the other groups.

Specimens found defective during the test of Group 0 shall not be used for the other groups.

“One defective” is counted when the number of surface mount preset potentiometers has not satisfied the whole or part of the tests of the group.

The approval is granted when the number of defectives does not exceed the specified number of permissible defectives for each group or subgroup and total number of permissible defectives.

NOTE In Table 3 the fixed sample size test schedule is given. It includes details of sampling and permissible defectives for different tests for groups of tests and gives, together with the details of the test contained in Clause 4 of IEC 60393-1 and in Clause 2 of this Sectional Specification, a complete summary of test conditions and performance requirements.

It is indicated in Table 3 where, for the test methods, test conditions and/or performance requirements, a choice has to be made in the Detail Specification.

The conditions of test and the performance requirements for the fixed sample size test schedule shall be identical to those prescribed in the Detail Specification for quality conformance inspection.

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**Table 3 – Fixed sample size test schedule for qualification approval –
Assessment level E**

Subclause number and test of IEC 60393-1 (see NOTE 1)	D or ND	Conditions of test (see NOTE 1)	Sample size and criterion of acceptability (see NOTE 2)			Performance requirements (see NOTE 1)
			<i>n</i>	<i>c</i>	<i>t</i>	
GROUP 0	ND		46+3 6)	1	1	
4.4.1 Visual examination						As in 4.4.1 of IEC 60393-1
4.6 Element resistance						As in 4.6.3 of IEC 60393-1
4.4.2 Dimensions (gauging)						As specified in the Detail Specification
4.7 Terminal resistance		Resistance between a and b Resistance between b and c				$R \leq \dots \Omega$ $R \leq \dots \Omega$
4.4.4 Total mechanical travel		- Lead screw styles: Effective operating turns				≥ 70 % of total mechanical travel
		- Rotary styles:				As specified in the Detail Specification
4.4.6 Effective electrical travel		- Lead screw styles - Rotary styles:				≥ 70 % of the measured total mechanical travel As specified in the Detail Specification
4.5 Continuity		See NOTE 3				As in 4.5.2 of IEC 60393-1
4.15 Rotational noise		Method B:				$\leq \dots \Omega$ or $\dots$ % <i>R</i> (whichever is the greater)
4.12 Voltage proof (Insulated potentiometers only)		Normal air pressure				As in 4.12.5 of IEC 60393-1
GROUP 1	D		8	1	1	
4.18 Starting torque						See Detail Specification
2.13.4 Solderability of IEC 60393-6 (not applicable to potentiometers which are not suitable for total immersion)		Aging, if applicable Solder bath method: Temperature: 235 °C ± 5 °C Duration: 2 s ± 0,5 s				As in 2.13.4 of IEC 60393-6 See Detail Specification
4.45 Solvent resistance of marking (if applicable)		Solvent: ... Solvent temperature: ... Method 1 Rubbing material: cotton wool Recovery: ...				See Detail Specification
4.14 Temperature characteristic of resistance		Lower category temperature/20 °C 20 °C/70 °C 20 °C/Upper category temperature				$\frac{\Delta R}{R} \leq \dots$ % $\frac{\Delta R}{R} \leq \dots$ % $\frac{\Delta R}{R} \leq \dots$ %

Subclause number and test of IEC 60393-1 (see NOTE 1)	D or ND	Conditions of test (see NOTE 1)	Sample size and criterion of acceptability (see NOTE 2)			Performance requirements (see NOTE 1)
			<i>n</i>	<i>c</i>	<i>t</i>	
4.20 End stop torque		- For types fitted with end stops: As specified in 4.20.1 Not less than five times the upper limit of the starting torque (unless otherwise stated by Detail Specification)				As in 4.20.1 of IEC 60393-1
		- For types fitted with slipping clutches: As specified in 4.20.2				As in 4.20.2 of IEC 60393-1
4.22 Thrust and pull on spindle		Only the thrust shall be applied. The pull is not applicable				
		- Half of the specimens As specified in 4.22.2 Continuity				As in 4.22.2 of IEC 60393-1
		- Remaining specimens As specified in 4.22.3 Output voltage ratio				$\Delta \frac{U_{ab}}{U_{ac}} \leq \dots \%$
4.40 Mechanical endurance		Number of cycles: ... Rate: - Rotary types: 5 cycles to 10 cycles per minute - Lead screw types: ... Visual examination Element resistance Starting torque Rotational noise Method B:				See Detail Specification As in 4.40.6 of IEC 60393-1 $\Delta R \leq \pm(\dots \% R + \dots \Omega)$... mN.m to ... mN.m $\leq \dots \Omega$ or $\dots \% R$ (whichever is the greater)
GROUP 2	D		13		2	
[1] 7 specimens			7	1		
1.4.2 of IEC 60393-6 Mounting		Substrate material and spacing: see 2.3.7 of this Sectional Specification				
2.1.3.2 of IEC 60393-6 Substrate bending test		Element resistance Visual examination				$\Delta R \leq \pm(\dots \% R + \dots \Omega)$ No visible damage
2.1.3.3 of IEC 60393-6 Resistance to soldering heat (not applicable to potentiometers which are not suitable for total immersion)		Visual examination Element resistance Terminal resistance: Resistance between <u>a</u> and <u>b</u> Resistance between <u>b</u> and <u>c</u>				As in 2.1.3.3 of IEC 60393-6 No visible damage $\Delta R \leq \pm(\dots \% R + \dots \Omega)$ $R \leq \dots \Omega$ $R \leq \dots \Omega$

Subclause number and test of IEC 60393-1 (see NOTE 1)	D or ND	Conditions of test (see NOTE 1)	Sample size and criterion of acceptability (see NOTE 2)			Performance requirements (see NOTE 1)
			<i>n</i>	<i>c</i>	<i>t</i>	
4.44 Component solvent resistance (if applicable)		Solvent: ... Solvent temperature: ... Method 2				See Detail Specification
4.31 Sealing (if applicable)		Recovery Temperature: 85 °C to 90 °C				As in 4.31.3 of IEC 60393-1
[2] 6 specimens			6	1		
1.4.2 of IEC 60393-6 Mounting		Substrate: Visual examination Element resistance				No visible damage $\Delta R \leq \pm(\dots \% R + \dots \Omega)$
4.34 Change of temperature		See NOTE 4 T_A = Lower category temperature T_B = Upper category temperature Visual examination Output ratio Element resistance				As in 4.34.5 of IEC 60393-1 $\Delta \frac{U_{ab}}{U_{ac}} \leq \dots \%$ $\Delta R \leq \pm(\dots \% R + \dots \Omega)$
4.36 Bump (or shock) (see 1.4.5.2 of IEC 60393-6)		For mounting method see Detail Specification Acceleration: 400 m/s ² Number of bumps: 4 000 Visual examination Element resistance				As in 4.36.3 of IEC 60393-1 $\Delta R \leq \pm(\dots \% R + \dots \Omega)$
4.37 Shock (or bump) (see 1.4.5.2 of IEC 60393-6)		For mounting method see Detail Specification Pulse shape: half sine Acceleration: 500 m/s ² Pulse duration: 11 ms Visual examination Element resistance				As in 4.37.3 of IEC 60393-1 $\Delta R \leq \pm(\dots \% R + \dots \Omega)$
4.35 Vibration		For mounting method see Detail Specification Frequency range: ... Hz to ... Hz Amplitude: 0,75 mm or acceleration 100 m/s ² (whichever is the less severe) Sweep endurance: Total duration: 6 h (see NOTE 4) Measurements during test Electrical continuity (as specified in 4.35.4)				There shall be no discontinuity > 100 µs

Subclause number and test of IEC 60393-1 (see NOTE 1)	D or ND	Conditions of test (see NOTE 1)	Sample size and criterion of acceptability (see NOTE 2)			Performance requirements (see NOTE 1)
			<i>n</i>	<i>c</i>	<i>t</i>	
		Final measurements Visual examination Output ratio Element resistance				As in 4.35.5 of IEC 60393-1 $\Delta \frac{U_{ab}}{U_{ac}} \leq \dots \%$ $\Delta R \leq \pm (\dots \% R + \dots \Omega)$
[3] All specimens			13	1	2	
4.38 Climatic sequence - Dry heat - Damp heat, cyclic, Test Db, first cycle - Cold - Low air pressure - Damp heat, cyclic, Test Db, remaining cycles - DC load - Insulation voltage - Final measurements		Visual examination Starting torque 8 kPa Voltage proof (insulated potentiometers only) See NOTE 5 See NOTE 5 Visual examination Element resistance Insulation resistance (insulated potentiometers only) Continuity Starting torque Voltage proof (insulated potentiometers only)				As in 4.38.2.2 of IEC 60393-1 ... mN.m to ... mN.m As in 4.38.5.3 of IEC 60393-1 As in 4.38.8 of IEC 60393-1 As in 4.38.10.1 of IEC 60393-1 $\Delta R \leq \pm (\dots \% R + \dots \Omega)$ $\geq 100 \text{ M}\Omega$ As in 4.5.1 of IEC 60393-1 ... mN.m to ... mN.m As in 4.38.10.7 of IEC 60393-1
GROUP 3 4.43.2 Electrical endurance at 70 °C	D	Duration: 500 h or 1000 h - Loaded between a and c : Examination at 48 h, 500 h and 1000 h Visual examination Element resistance - Loaded between a and b: Examination at 48 h, 500 h and 1000 h Visual examination Resistance between a and b: Element resistance	8	1		As in 4.43.2.6 of IEC 60393-1 $\Delta R \leq \pm (\dots \% R + \dots \Omega)$ As in 4.43.2.6 1) of IEC 60393-1 $\Delta R \leq \pm (\dots \% R + \dots \Omega)$ $\Delta R \leq \pm (\dots \% R + \dots \Omega)$