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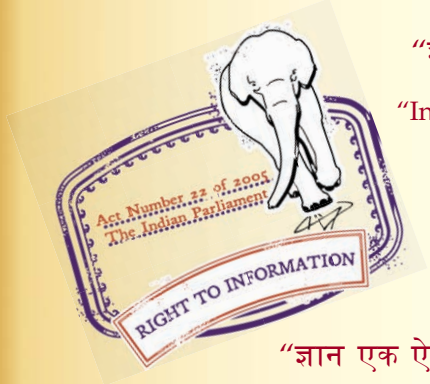

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Indian Standard

SPECIFICATION FOR DIRECTLY HEATED NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS

PART I GENERAL REQUIREMENTS AND METHODS OF TESTS

UDC 621·316·825·4

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Indian Standard

SPECIFICATION FOR DIRECTLY HEATED NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS

PART I GENERAL REQUIREMENTS AND METHODS OF TESTS

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Indian Standard

SPECIFICATION FOR DIRECTLY HEATED NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS

PART I GENERAL REQUIREMENTS AND METHODS OF TESTS

0. FOREWORD

0.1 This Indian Standard (Part I) was adopted by the Indian Standards Institution on 25 April 1979, after the draft finalized by the Resistors Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 The object of this standard is to establish uniform requirements for judging the electrical, mechanical and climatic properties of directly heated negative temperature coefficient thermistors (NTC-D) and to describe test methods as well as to give preferred values of zero-power resistance, tolerances, maximum power rating and classification into climatic categories according to their ability to withstand conditions as specified in IS : 589-1961*.

0.3 This standard is based on IEC Pub 539-1976, Directly Heated Negative Temperature Coefficient Thermistors, issued by the International Electrotechnical Commission.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This standard covers directly heated thermistors, insulated and non-insulated types, with negative temperature coefficients (NTC-D).

*Basic climatic and mechanical durability tests for components for electronic and electrical equipment (*revised*).

†Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.1 For the purpose of this standard, the following definitions in addition to those given in IS : 1885 (Part XLVI)-1976*, shall apply.

2.2 Type Tests — Tests carried out to prove conformity with the requirements of this standard. These are intended to prove the general quality and design of a particular type of thermistor.

2.3 Acceptance Tests — Tests carried out on samples of thermistors selected from a lot for the purpose of acceptance of the lot.

2.4 Routine Tests — Tests carried out on each thermistor to check the requirements which are likely to vary during production.

3. CLIMATIC CATEGORIES

3.1 The thermistors covered by this standard are classified into climatic categories according to the general rules given in IS : 589-1961†.

3.2 The following climatic categories are preferred:

Category	*Temperature Range*	*Damp Heat (Long Term)*
10/85/04	− 10°C to + 85°C	4 days
10/125/04	− 10°C to + 125°C	4 days
55/125/21	− 55°C to + 125°C	21 days
55/155/21	− 55°C to + 155°C	21 days
55/155/56	− 55°C to + 155°C	56 days
55/200/21	− 55°C to + 200°C	21 days

4. RATINGS

4.1 Rated Zero-Power Resistance — The preferred values of the rated zero-power resistance shall be taken from the following series:

1; 1·5; 2·2; 3·3; 4·7; 6·8 and their decimal multiples (E 6 series of IS : 824-1965‡).

NOTE — If other values are needed, they shall be chosen from the finer series (E 12 or E 24).

4.2 Tolerances on Rated Zero-Power Resistance — The preferred tolerances on the rated zero-power resistance are:

±2, ±5, ±10, ±20 and ±30 percent

*Electrotechnical vocabulary: Part XLVI Resistors.

†Basic climatic and mechanical durability tests for components for electronic and electrical equipment (*revised*).

‡Preferred values for resistors and capacitors (*revised*).

4.3 Maximum Power Rating (Where Applicable) — The preferred values of maximum power rating at 25°C are:

50 μW; 100 μW
25 mW; 50 mW; 100 mW; 500 mW
1 W; 1·6 W; 2 W; 2·5 W

NOTE — For new developments, the maximum power rating values at 25°C shall be taken from the following series:

1; 1·6; 2·5; 4; 6·3

and their decimal multiples or sub-multiples. (R5 series of IS : 1076-1967*).

5. MATERIAL, CONSTRUCTION AND WORKMANSHIP

5.1 Material — Thermistors shall be constructed from the most suitable materials which shall be free from flaws. All materials used in the construction of the thermistors shall be such as are not susceptible to any mutual chemical reaction over the entire range of temperature in which the thermistor is designed to operate.

5.1.1 Materials used in the moulding and coating of thermistors shall not support combustion.

5.2 Construction

5.2.1 The body of the thermistor shall be free from cracks, holes, chips or malfunctions. The wire leads shall be unbroken, not crushed or nicked.

5.2.2 Electrical connections shall be mechanically secure and electrically continuous both before and after soldering.

5.3 Finish — Unless otherwise specified, all exposed materials liable to deterioration in moist or other corrosive atmosphere shall be given suitable finish.

5.4 Workmanship — All parts shall be manufactured in a thoroughly workman-like manner and in accordance with good engineering practice.

6. MARKING

6.1 Following marking information is required in the order of importance given below:

a) Rated zero-power resistance.

NOTE — This value may be indicated by a letter or colour code, as specified in IS : 8186-1976†.

b) Tolerance on rated zero-power resistance.

NOTE — Tolerances may be indicated by a letter or colour code, as specified in IS : 8186-1976†.

*Preferred numbers (*first revision*).

†Marking codes for values and tolerances of resistors and capacitors.

c) Maximum power rating.

d) Climatic category.

e) Name of the manufacturer or trade-mark.

f) Manufacturer's type designation.

g) Year and month (or week) of manufacture. This may be given in code form (*see* IS : 8186-1976*).

6.2 The thermistors shall be clearly marked with **6.1**(a) if space permits.

6.3 The thermistor(s) or the package, shall be clearly marked with all the information of **6.1.**

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

6.5 The thermistor(s) or its package may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

7. TESTS

7.1 Classification of Tests

7.1.1 *Type Tests* — Unless otherwise specified, the procedure for type approval shall be in accordance with IS : 2612-1965†. The sequence of type tests shall be in accordance with Table 1.

7.1.1.1 *Number of samples* — The sample shall be representative of the range of values of the type under consideration. The appropriate number of samples to be tested shall be agreed between the purchaser and the manufacturer. Any part or sub-part of a sample subjected to a series of tests shall contain a minimum of five specimens of a particular value, rating and type. Number of samples for type approval shall be as given in the relevant detail specification.

*Marking codes for values and tolerances of resistors and capacitors.

†Recommendation for type approval and sampling procedures for electronic components.

7.1.2 Routine tests shall be as specified in the relavant detail specification.

7.1.3 *Acceptance Tests* — Acceptance tests and criteria for accepting the lot shall be as specified in the relevant detail specification.

TABLE 1 SCHEDULE OF TYPE TESTS

(*Clause* 7.1.1)

GROUP	TEST		CLAUSE REFERENCE
(1)	(2)		(3)
0	Visual examination		7.4.1.2
	Dimensions		7.4.1.1
	Zero-power resistance		7.3.1
	B-value or Resistance ratio		7.3.2
1	Insulation resistance	First half	7.3.3
	Voltage proof	First half	7.3.4
	Robustness of terminations	First half	7.4.2
	Soldering	First half	7.4.3
	Rapid change of temperature	Second half	7.7
	Vibration	Second half	7.4.5
	Bump	Second half	7.4.6
	Climatic	All specimens	7.5
2	Resistance/temperature characteristic		7.3.5
	Dissipation factor δ		7.3.6
	Thermal time constant		7.3.7
	Endurance (upper category temperature)		7.9
3	Damp heat (long term)		7.6
4	Endurance (at room temperature)		7.8

7.2 General Conditions for Tests

7.2.1 Because thermistors are very sensitive to temperature variations, calculations from measurements taken during the course of a test are referred to a reference temperature. Unless otherwise specified in the detail specification, the reference temperature shall be 25°C.

7.2.2 Unless otherwise specified, all tests shall be carried out under standard atmospheric conditions for testing as specified in IS : 589-1961*, except the reference temperature as given in **7.2.1**.

7.2.3 All tests involving close control of temperature shall be made with the thermistor immersed in a well-stirred bath of non-conducting, non-corrosive liquid maintained at the reference temperature.

*Basic climatic and mechanical durability tests for components for electronic and electrical equipment (*revised*).

7.2.4 Before the measurements are made, the thermistor shall be maintained at the measuring temperature until temperature equilibrium is reached.

When measurements are made at a temperature other than the specified temperature, the results shall, where necessary, be corrected to the specified temperature. The ambient temperature during the measurements shall be stated in the test report.

NOTE — During measurements, the thermistor shall not be exposed to draughts, direct sun-rays or other influences likely to cause error.

7.2.5 The total error of measurement from power dissipation, temperature tolerance and the error of the measuring equipment shall not exceed 10 percent of the tolerance specified in the relevant specification.

7.2.6 Where drying is called for in the specification, the thermistor shall be conditioned before measurement is made, using Procedure I or Procedure II as called for in the relevant detail specification.

Procedure I: For 24 ± 4 hours in an oven at a temperature of 55 ± 2°C and relative humidity not exceeding 20 percent.

Procedure II: For 96 ± 4 hours in an oven at 100 ± 5°C.

The thermistor 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.

7.2.7 Where recovery is required, the thermistor shall be stored at standard atmospheric conditions for testing for 4 ± 1 hour.

7.2.8 The stages of each test shall be carried out in the specified order.

7.3 Electrical Tests

7.3.1 *Zero-Power Resistance*

7.3.1.1 The zero-power resistance shall be measured at the reference temperature ±0·1°C (*see* **7.2.1**).

7.3.1.2 The thermistors shall be mounted by their normal means in corrosion resistance clips on a mounting plate made of polytetrafluoroethylene or equivalent insulating material.

Thermistors without wire terminations shall be supported by pressure contact between brass pressure contact plates mounted on 3 mm brass rods. The rods shall be set to position the thermistor correctly.

Preferred mountings are given in Appendix A primarily for measurements in air where self-heating may occur. This mounting shall be used in case of dispute.

The thermistors shall then be immersed in a non-corrosive medium temperature of which shall be controlled in accordance with the relevant sub-clause. The measuring method shall be such that the error does not exceed:

a) for absolute resistance measurements:	10 percent of the rated resistance tolerance;
b) for measurements of variation of resistance:	10 percent of the specified maximum change of resistance

7.3.1.3 *Requirement* — The zero-power resistance shall be within the specified tolerance on the rated zero-power resistance.

NOTE — Where polarity effects occur, their effect on the tolerance shall be agreed upon between purchaser and manufacturer.

7.3.2 *B-Value or Resistance Ratio*

7.3.2.1 The B-value shall be calculated using the zero-power resistance values measured at 25 ± 0·1°C and at 85 ± 0·1°C using the method specified in **7.3.1.2**.

7.3.2.2 The B-value or the resistance ratio shall be within the specified tolerance.

7.3.3 *Insulation Resistance* (*for Insulated Types only*)

7.3.3.1 *Test methods* — According to the instruction given in the relevant specification, one of the following test methods shall be used:

a) *Method 1* — The non-insulated parts of the thermistor shall be wrapped in insulating material of very high insulation value. The whole is inserted into a box containing lead balls of 1·6 ± 0·2 mm diameter, in such a manner that only the connections of the thermistor emerge. An electrode is inserted into the lead balls.

b) *Method 2* — A metal foil shall be wrapped closely around the body of the thermistor. For those types not having axial leads, a space of 1 mm to 1·5 mm shall be left between the edge of the foil and each termination. For those types having axial leads, the foil shall be wrapped around the whole body of the thermistor protruding by at least 5 mm from each end, provided that the minimum space of 1 mm between the foil and each termination can be maintained. The ends of the foil shall not be folded over the ends of the thermistor.

c) *Method 3* — The thermistor should be clamped in the trough of a 90° metallic V-block of such size that the thermistor body does not extend beyond the extremities of the block. The clamping force shall be such as to maintain adequate contact between the

thermistor and the block. The terminations shall be so positioned that the distance between the terminations and any point of the V-block is not less than:

1) *For cylindrical thermistors*: the radius of the thermistor body minus the radius of the circumscribed circle of the terminations (the larger circle in case the two terminations have different dimensions);
2) *For rectangular thermistors*: half the smaller side of thermistor body minus the radius of the circumscribed circle of the terminations (the larger circle in case the two terminations have different dimensions).

Any out-of-centre positioning of the termination at its emergence from thermistor body shall be ignored.

7.3.3.2 The insulation resistance shall be measured with a direct voltage of 100 ± 15 volts between both terminations of the thermistor connected together as one pole and the lead 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.

7.3.3.3 *Requirement* — When thermistors are measured as specified in **7.3.3.1** and **7.3.3.2** for insulation resistance of the protective coating, the insulation resistance shall not be less than the appropriate value specified in the relevant specification.

7.3.4 *Voltage Proof (for Insulated Types only)*

7.3.4.1 *Test methods* — As required by the relevant specification, one of the test methods given in **7.3.3.1** is used.

7.3.4.2 An alternating voltage with a frequency of 40 Hz to 60 Hz and with a peak value of 700 V unless otherwise specified, shall be applied for 1 min ±5 s between all terminations of the thermistor connected together as one pole and the lead balls, the metal foil or the V-block as the other pole.

The voltage shall be applied gradually at a rate of approximately 100 volt per second.

7.3.4.3 *Requirements* — There shall be no breakdown.

7.3.5 *Resistance/Temperature Characteristic*

7.3.5.1 The resistance/temperature characteristic shall be measured in the manner described below.

7.3.5.2 Zero-power resistance measurement shall be made in accordance with the method specified in **7.3.1.2** at each of the temperature indicated by the letter "×" in the table below in the column under the appropriate temperature category.

Test Temperature	*Temperature Category*				
	10/085	10/125	55/125	55/155	55/200
(1)	(2)	(3)	(4)	(5)	(6)
+ 25 ± 0·1°C	×	×	×	×	×
− 55 ± 1·0°C	—	—	×	×	×
− 25 ± 0·5°C	—	—	×	×	×
− 10 ± 0·5°C	×	×	—	—	—
0 ± 0·1°C	×	×	×	×	×
+ 25 ± 0·1°C	×	×	×	×	×
+ 85 ± 0·1°C	×	×	×	×	×
+125 ± 0·5°C	—	×	×	×	×
+155 ± 1·0°C	—	—	—	×	—
+200 ± 1·0°C	—	—	—	—	×
+ 25 ± 0·1°C	×	×	×	×	×

The measurements shall be recorded.

7.3.5.3 When calculating the resistance/temperature characteristic, for the lower part of the category temperature range, the mean of the first two measured values at 25°C, and for the upper part, the mean of the last two measured values at 25°C shall be used as reference.

7.3.5.4 *Requirement* — The resistance/temperature characteristic shall be within the limits specified in the relevant detail specification.

7.3.6 *Dissipation Factor* (δ)

7.3.6.1 The zero-power resistance shall be measured at the temperature T_1, which is 85 ± 0·1°C, unless otherwise specified in the detail specification, and the value shall be recorded.

7.3.6.2 Unless otherwise specified by the detail specification, thermistors with wire terminations shall be gripped by clips (as described in Appendix A) of 1·3 mm diameter phosphor-bronze wires. The clips shall grip the terminations 25 ± 1·5 mm from the body of the thermistor. In any event, this method shall be used in case of dispute.

Unless otherwise specified by the detail specification, thermistors without wire terminations shall be supported by pressure contact between

phosphor-bronze pressure contacts (as described in Appendix A) of 1·3 mm diameter. In any event, this method shall be used in case of dispute.

The wires carrying the thermistors shall then be enclosed in a box having a volume at least 1 000 times greater than that of the thermistors under test. The wires shall be so positioned that no thermistor is within 75 mm of any other thermistor or the walls of the box. The air in the box shall not be agitated and shall be at a temperature of 25 ± 0·5°C. Before insertion in the box, the thermistor shall be connected in the circuit shown in Fig. 1.

The high-impedance voltmeter and the ammeter shall have an accuracy better than 1 percent.

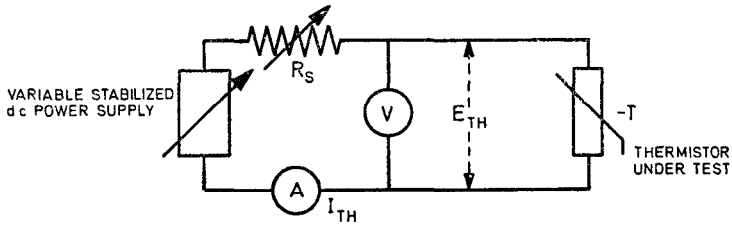

FIG. 1 DISSIPATION FACTOR MEASURING CIRCUIT

7.3.6.3 The current I_{TH} shall be adjusted until the ratio E_{TH} equals, within 5 percent, the zero-power resistance value at T_1 recorded in **7.3.6.1**. When stable readings have been achieved, the values of E_{TH} and I_{TH} shall be recorded.

7.3.6.4 The dissipation factor (δ) shall be calculated using the following formula:

$$\delta \frac{E_{TH} \cdot I_{TH}}{T_1 - 25°C} \text{ mW/°C}$$

where

E_{TH} is measured in volts

I_{TH} is measured in milliamperes

7.3.6.5 *Requirement* — The dissipation factor shall be within the limits specified in the relevant detail specification.

7.3.7 *Thermal Time Constant* (T)

7.3.7.1 The zero-power resistance shall be measured according to the method specified in **7.3.1.2** at 47·1 ± 0·1°C and at 85 ± 0·1°C, or at two other temperatures which comply with the definition of thermal time constant and given in the relevant detail specification. Measurements shall be recorded.

7.3.7.2 Unless otherwise specified, the thermistor shall be mounted on rods and enclosed in a box as described in **7.3.6.2**. Before insertion in the box, the thermistor shall be connected in the circuit shown in Fig. 2. The high impedance voltmeter and the ammeter shall have an accuracy better than 1 percent. The resistance measuring equipment shall have an accuracy of 0·1 percent or better.

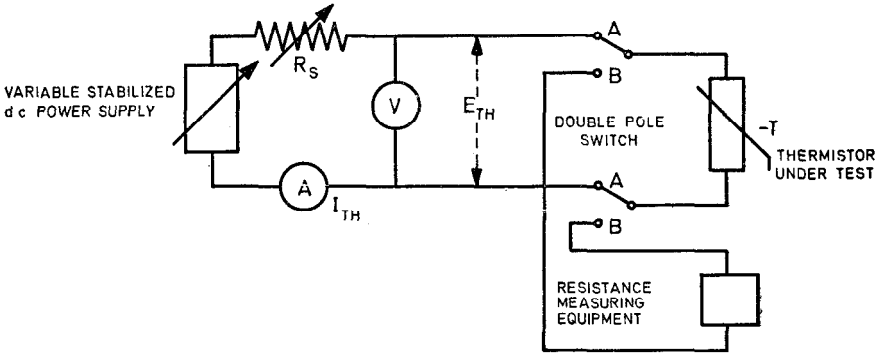

FIG. 2 THERMAL TIME CONSTANT MEASURING CIRCUIT

7.3.7.3 *Method of measurement* — With contacts *AA* closed, the current I_{TH} shall be adjusted until the ratio of $\frac{E_{TH}}{I_{TH}}$ is within 60 percent and 80 percent, of zero-power resistance for 85°C or another specified temperature (*see* **7.3.7.2**) and stable readings have been achieved. Throw switch to close contacts *BB*, and start the timing when the zero-power resistance at 85°C or another specified temperature (*see* **7.3.7.2**) is obtained. Stop the timing when the zero-power resistance at 47·1°C or another specified temperature (*see* **7.3.7.2**) is reached. The time elapsed between start and stop of the timing is the thermal time constant.

7.3.7.4 *Requirement* — The thermal time constant shall be within the limits specified in the relevant detail specification.

7.4 Physical and Mechanical Tests

7.4.1 *Visual Examination and Check of Dimensions*

7.4.1.1 The dimensions shall be checked and they shall comply with the values specified in the detail specification.

7.4.1.2 The conditions, workmanship, marking and finish shall be satisfactory as determined by visual examination.

7.4.1.3 The marking shall be legible.

7.4.2 *Robustness of Terminations* — The zero-power resistance shall be measured according to **7.3.1** and shall be recorded.

The thermistors shall be subjected to the procedure of tests **7.19** of IS : 589-1961*.

7.4.2.1 *Tensile* — The loading weight to be applied for 10 seconds shall be:

a) For all types of terminations except wire terminations: 20 N

b) For wire terminations (*see* table below)

Cross-sectional area of the wire (the corresponding diameter of round wire is given between brackets) mm²	*Load* N
Exceeding 0·5 (0·8 mm)	20
Exceeding 0·2 (0·5 mm) up to and including 0·5 (0·8 mm)	10
Exceeding 0·07 (0·3 mm) up to and including 0·2 (0·5 mm)	5
Up to and including 0·07 (0·3 mm)	2·5

7.4.2.2 *Bending (half the number of terminations)* — Two consecutive bends shall be applied.

7.4.2.3 *Torsion (other half of the terminations)* — Two rotations of 180°C shall be applied.

7.4.2.4 *Visual examination* — After each of these tests, the thermistors shall be visually examined. There shall be no visible damage.

7.4.2.5 *Final measurements and requirements* — After the test, the zero-power resistance shall be measured according to **7.3.1**. The change of resistance value shall not exceed the limit specified in the relevant detail specification.

7.4.3 *Soldering*

7.4.3.1 *Solderability*

7.4.3.2 Unless otherwise specified, the thermistor shall be subjected to the solderability test using the solder bath method of test **7.1.8.2** of IS : 589-1961*. All terminations of the thermistor shall be tested.

7.4.3.3 The thermistors shall be visually examined. Immersed parts shall be correctly tinned.

*Basic climatic and mechanical durability tests for components for electronic and electrical equipment (*revised*).

7.4.4 *Resistance to Soldering Heat*

7.4.4.1 The thermistors shall be dried according to Procedure I of **7.2.6**. The zero-power resistance shall be measured using the method specified in **7.3.1** and shall be recorded.

7.4.4.2 The thermistors shall be subjected to the resistance to soldering heat test using the solder bath method. All terminations of the thermistor shall be tested (*see* **7.18.2** of IS : 589-1961*).

7.4.4.3 The thermistors shall be visually examined. There shall be no visible damage.

7.4.4.4 After recovery according to **7.2.7** the zero-power resistance shall be measured as specified in **7.3.1.**

7.4.4.5 The change of resistance shall not exceed 2 percent unless otherwise specified in the relevant detail specification.

7.4.5 *Vibration*

7.4.5.1 The thermistors shall be securely mounted by their termination and/or by their normal mounting means.

7.4.5.2 The thermistors shall be subjected to the vibration test as per **7.6** of IS : 589-1961* using the appropriate degree of severity as specified in the relevant detail specification.

7.4.5.3 During the last hour of vibration in each direction of movement, an electrical measurement shall be made to determine intermittent contact or open or short-circuits. Detecting equipment shall be sufficiently sensitive to detect any interruption with a duration of 0·5 ms or greater.

7.4.5.4 After the test, the thermistors shall be visually examined. There shall be no visible damage.

7.4.5.5 The zero-power resistance shall then be measured using the method specified in **7.3.1**. The change of resistance value shall not exceed the limit specified in the relevant detail specification.

7.4.6 *Bump*

7.4.6.1 Mounting shall be as specified in **7.4.5.1.**

7.4.6.2 The thermistors shall be subjected to the bump test as per **7.5.1** of IS : 589-1961*, using the appropriate degree of severity as specified in the relevant detail specification.

*Basic climatic and mechanical durability tests for components for electronic and electrical equipment (*revised*).

7.4.6.3 After the test, the thermistors shall be visually examined. There shall be no visible damage.

7.4.6.4 The zero-power resistance shall then be measured using the method specified in **7.3.1**. The change of resistance shall not exceed the limit specified in the relevant detail specification.

7.5 Climatic Sequence

7.5.1 *Initial Measurement*

7.5.1.1 The thermistors shall be dried using Procedure 1 of **7.2.6**.

7.5.1.2 The zero-power resistance shall be measured using the method specified in **7.3.1** and the value shall be recorded.

7.5.2 *Dry Heat* — The thermistors shall be subjected to the dry heat test as per **7.2** of IS : 589-1961*, for a duration of 16 hours, using the appropriate degree of severity.

7.5.3 *Damp Heat (Accelerated) First Cycle*

7.5.3.1 The thermistors of categories -/-/56 and -/-/21 shall be subjected to this test as per **7.4** of IS : 589-1961* for one cycle of 24 hours.

7.5.3.2 After recovery the thermistors shall be subjected immediately to the cold test.

7.5.4 *Cold* — The thermistors shall be subjected to the cold test as per **7.1** of IS : 589-1961* for a duration of 2 hours, using the appropriate degree of severity.

7.5.5 *Low Air Pressure (if Specified in the Relevant Specification)*

7.5.5.1 The thermistors shall be subjected to this test as per **7.12** of IS : 589-1961*, using the appropriate degree of severity.

7.5.5.2 The test shall be made at any temperature between 15°C and 35°C and the duration of the test shall be one hour.

7.5.6 *Damp Heat (Accelerated) Remaining Cycles* — The thermistors shall be subjected to this test as per **7.4** of IS : 589-1961* for the following number of cycles.

Category	*Number of Cycles*
-/-/56	5
-/-/21	1
-/-/04	None

*Basic climatic and mechanical durability tests for components for electronic and electrical equipment (*revised*).

7.5.7 *Final Measurements*

7.5.7.1 The thermistors shall be visually examined. There shall be no visible damage and the marking shall be legible.

7.5.7.2 The zero-power resistance shall be measured using the method specified in **7.3.1**. The change in resistance shall not exceed the limit specified in the relevant detail specification. For insulated types, the insulation resistance shall be measured and the voltage proof test carried out. The insulation resistance shall not be less than 100 MΩ. The thermistors shall withstand the voltage proof test without breakdown or flashover.

7.6 Damp Heat (Long Term)

7.6.1 The zero-power resistance shall be measured using the method specified in **7.3.1** and the value shall be recorded.

7.6.2 The non-insulated thermistors shall be subjected to this test as per **7.3** of IS : 589-1961* using the appropriate degree of severity.

7.6.3 For insulated types, the same procedure shall be applied but if specified in the relevant detail specification, a polarization voltage of 1/20 of the voltage (taken from the R5 series) corresponding to the maximum dissipation may be applied to the thermistor during the test.

7.6.4 At the end of this period, the thermistors shall be removed from the chamber and shall then be subjected to recovery according to **7.2.7**.

7.6.5 The thermistors shall then be visually examined. There shall be no visible damage and the marking shall be legible.

7.6.6 The zero-power resistance shall be measured, using the method specified in **7.3.1**. The change in resistance shall not exceed the limit specified in the relevant detail specification. For insulated types, the insulation resistance shall be measured and the voltage proof test carried out. The insulation resistance shall be not less than 100 MΩ. The thermistors shall withstand the voltage proof test without breakdown or flashover.

7.7 Rapid Change of Temperature

7.7.1 The zero-power resistance shall be measured using the method specified in **7.3.1** and shall be recorded.

7.7.2 The thermistors shall then be subjected to this test as per **7.14** of IS : 589-1961* for five cycles. The time of exposure at each extreme temperature is 30 minutes.

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*Basic climatic and mechanical durability tests for components for electronic and electrical equipment (*revised*).

7.7.3 The thermistors shall be visually examined. There shall be no visible damage. After recovery according to **7.2.7** the zero-power resistance shall be measured. The change of resistance shall not exceed the limit specified in the relevant detail specification.

7.8 Endurance (at Room Temperature)

7.8.1 The zero-power resistance shall be measured using the method specified in **7.3.1** and the value shall be recorded.

7.8.2 The thermistors shall be subjected to an endurance test of 1 000 h at an ambient temperature between 15°C and 35°C. The temperature shall remain within ± 2°C of that at the beginning of the test.

7.8.3 Thermistors with wire leads shall be connected so that their terminations have an effective length of 20 to 25 mm, unless otherwise specified in the relevant specification.

Printed circuit type thermistors shall be connected at a point 15 to 20 mm from the thermistor body.

Thermistors without leads shall be mounted by their normal means as prescribed in the relevant specification.

The thermistors shall be so placed that the temperature of any one thermistor shall not appreciably influence the temperature of any other thermistor. There shall be no undue draught on the thermistors.

7.8.4 The thermistors shall be connected in the circuit shown in Fig. 1.

7.8.5 The current I_{TH} shall be adjusted to reach the maximum power rating (P_{max}) at 25°C. The power shall be applied intermittently 1·5 h on and 0·5 h off for 1 000 $\pm$ 48 h.

7.8.6 After approximately 48, 168 and 1 000 hours, the load shall be removed and the thermistors allowed to recover according to **7.2.7** for not less than 4 hours. The removal from the power shall take place at the end of the half-hour off period.

After intermediate measurements, the thermistors shall be returned to the conditions of test. The interval between the removal from, and the return to, the conditions of test for any thermistor shall not exceed 12 hours.

7.8.7 The thermistors shall then be visually examined. There shall be no visible damage and the marking shall be legible.

The zero-power resistance shall be measured using the method specified in **7.3.1**. The change of resistance compared with the value measured in **7.8.1** shall not exeeed the limit specified in the relevant detail specification.

7.9 Endurance (at Upper Category Temperature)

7.9.1 The zero-power resistance shall be measured using the method specified in **7.3.1** and the value shall be recorded.

7.9.2 The thermistors shall be placed in a test chamber at the upper category temperature ± 2°C for 1 000 hours and at zero dissipation. The thermistors shall be placed in the chamber in such a manner that the spacing between thermistors is at least one diameter.

7.9.3 After 1 000 ± 48 hours, the thermistors shall be removed from the chamber and allowed to recover according to **7.2.7** for not less than 4 h.

7.9.4 The zero-power resistance shall be measured using the method specified in **7.3.1.** The change in resistance compared with the value measured in **7.9.1** shall not exceed the limit specified in the relevant detail specification.

APPENDIX A

(*Clauses* 7.3.1.2 *and* 7.3.6.2)

MOUNTING FOR MEASUREMENTS OF DIRECTLY HEATED THERMISTORS

A-1. MOUNTING FOR THERMISTORS WITHOUT LEADS

A-1.1 Thermistors without wire terminations shall be pressed between the phosphor-bronze wires of 1·3 mm ± 10% diameter, mounted on a base of insulating material, as shown in Fig. 3 and 4.

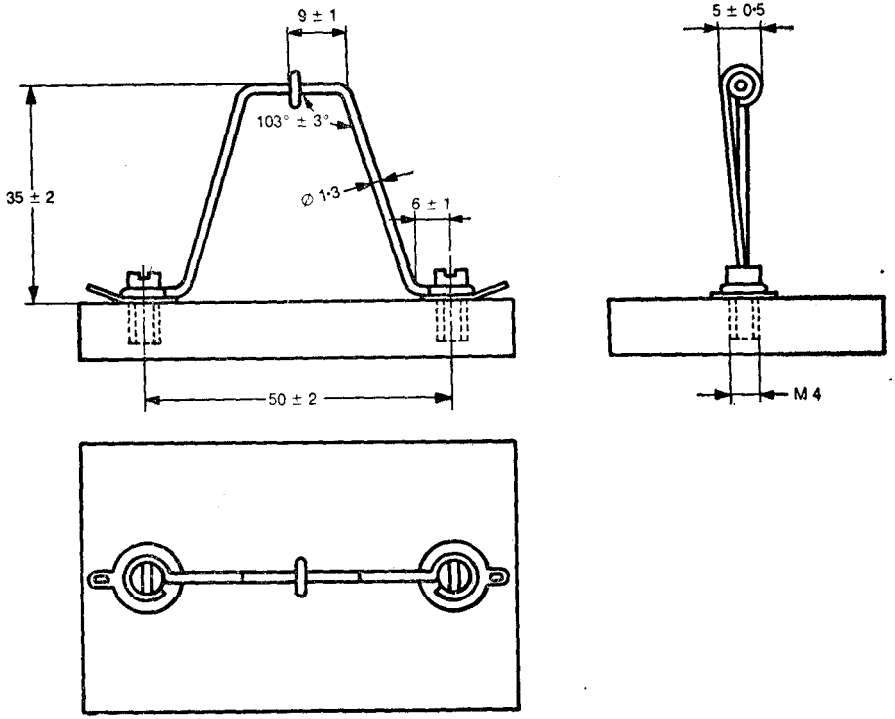
A-1.2 The measuring voltage shall be applied via an ammeter to contacts *A* and *D* (or *B* and *C*) and the voltage drop shall be measured between contracts *B* and *C* (or *A* and *D*).

A-2. MOUNTING FOR THERMISTORS WITH LEADS

A-2.1 Thermistors with leads shall be connected (but not soldered) to phosphor-bronze wires of 1·3 mm ± 10 percent diameter, mounted on a base of insulating material, as shown in Fig. 5.

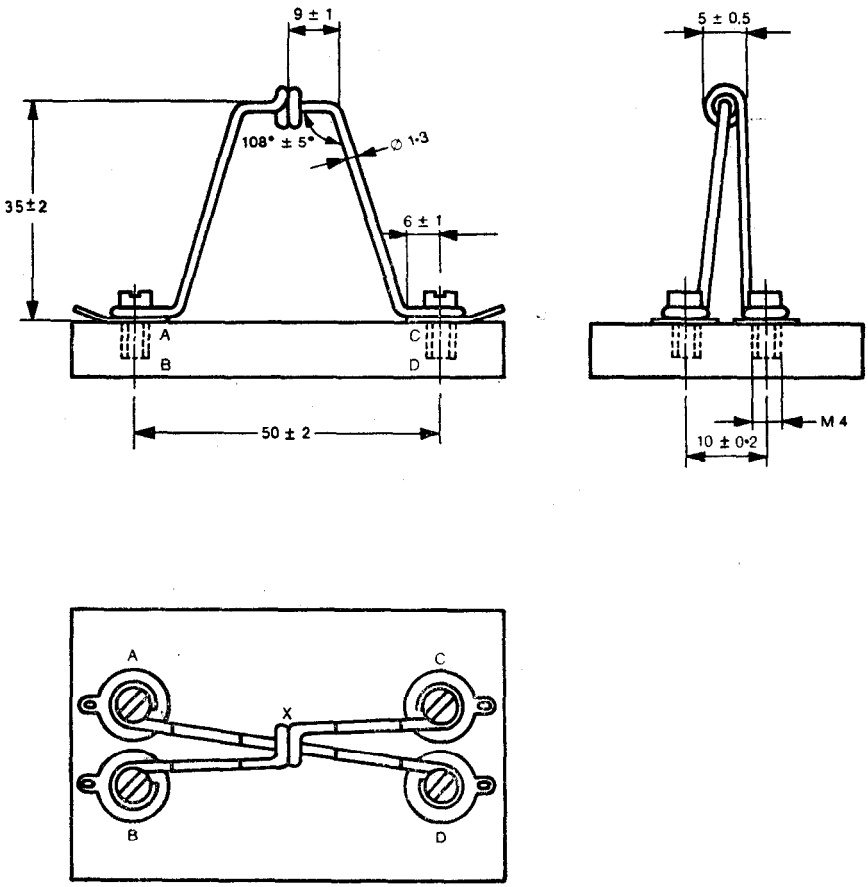
A-2.2 For thermistors of values $\geqslant 10\Omega$ contacts *AC* and *BD* or *AB* and *CD* may be used together.

For thermistors of value $< 10\ \Omega$ the measuring method with four contact points shall be used. The measuring voltage shall be applied via an ammeter to contacts *A* and *D* (or *B* and *C*) and the voltage drop shall be measured between contacts *B* and *C* (or *A* and *D*).



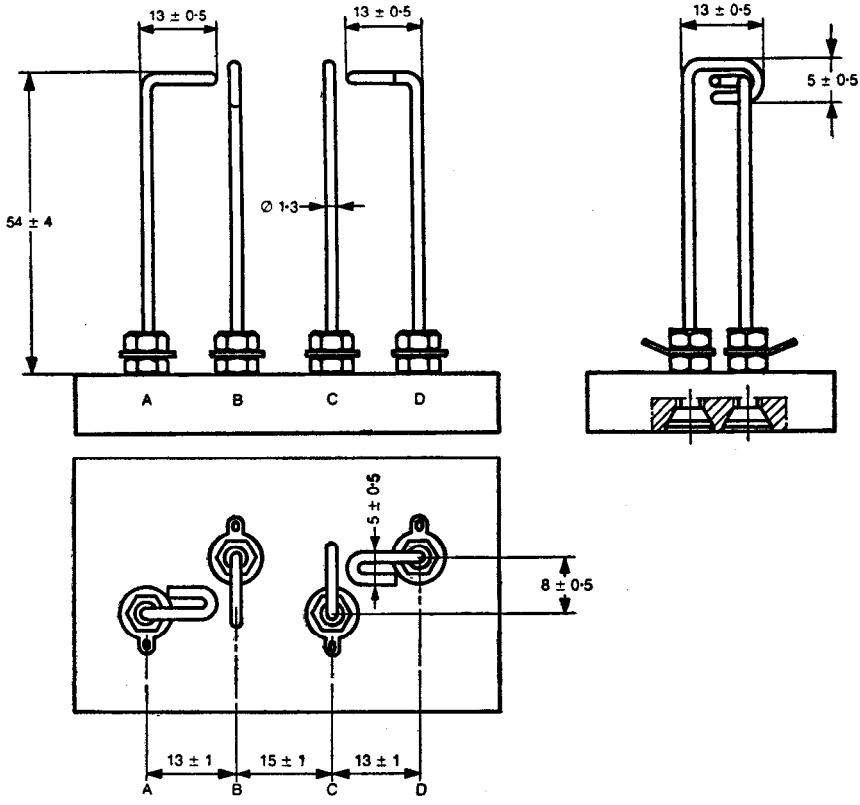
All dimensions in millimetres.

FIG. 3 MOUNTING FOR VALUES $\geqslant 10\ \Omega$ (MEASUREMENTS WITH TWO CONTACT POINTS)



All dimensions in millimetres.

FIG. 4 MOUNTING FOR VALUES $< 10\ \Omega$ (MEASUREMENT WITH FOUR CONTACT POINTS)



All dimensions in millimetres.

FIG. 5 MOUNTING FOR MEASUREMENTS OF HIGH & LOW VALUE THERMISTORS