IS : 11287 - 1985
(Reaffirmed 1991)
(Reaffirmed 1997)

Indian Standard

SPECIFICATION FOR BRIDGE INSULATIONS TESTERS (MAGNETO GENERATOR TYPE)

(First Reprint MAY 1997)

UDC 621·317·733

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 4 *December* 1985

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SPECIFICATION FOR BRIDGE INSULATIONS TESTERS (MAGNETO GENERATOR TYPE)

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 26 February 1985, after the draft finalized by the Electrical Measuring Instruments Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard deals with the hand generator type insulation testers with bridge facilities which is a very convenient instrument for measurement of (a) insulation resistance, (b) loop resistance of cables or coil resistance, (c) localization of fault in the cables. It comprises of a hand generator, one or more moving coil instrument(s) and a Wheatstone bridge with loop facilities.

0.3 It is recognized that for bridge insulation testers for use in hazardous and stringent environmental conditions, special provisions concerning environmental testing may be necessary. It is recommended that in such cases these requirements should be additionally specified.

0.4 In the preparation of this standard, assistance has been derived from the following:

JISG — 1301-1957 issued by Japanese Industrial Standard Committee.

ITD — S/XC/103 (Draft) issued by Indian Posts and Telegraphs Department.

Speen No. DTD&P (AIR) E & I — 317 issued by Directorate of Technical Development & Production, Ministry of Defence.

0.5 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.

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

1. SCOPE

1.1 This standard covers the requirements of portable bridge insulation testers (hand operated) enclosing in the same case a generator having a rated voltage of 100 volts or more.

1.1.1 The scope of this standard is confined to hand-operated bridge insulation resistance testers. Mains-operated and motor-driven bridge insulation resistance testers may have to comply with additional requirements which do not form part of this standard.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Rated Voltage — The open circuit voltage at the tester between the 'Line' and 'Earth' terminals with the selector switch at the 'Insulation' position as assigned by the manufacturer.

2.2 Rated Insulation Resistance — The resistance indicated by the tester corresponding to the scale mark nearest to the scale mark of infinity.

2.3 Effective Range of Measurement — That part of the scale where measurement can be made with the stated accuracy.

2.3.1 The range of insulation resistance value from 1/1 000 up to 1/10 of the rated insulation resistance value, shall be termed as first effective insulation range and the range of insulation resistance from 1/10 of the rated insulation resistance to the rated insulation resistance value is termed and second effective insulation range.

2.4 Central Scale Mark — The scale mark corresponding to 1/50 of the rated insulation resistance with the scale values of 1, 2, 5 or an integral power of 10 or multiples thereof.

2.5 Error in Indication — The difference between the indicated value and the true value of the quantity being measured. The error is positive if the indicated value is greater and negative if it is smaller than the true value.

2.6 Ripple Factor — The ratio of the ripple magnitude to the arithmetic mean voltage.

2.6.1 *Ripple* — The periodic deviation from arithmetic mean voltage. The magnitude of the ripple is defined as half the difference between the maximum and minimum values.

2.7 Indicator — The permanent magnet moving coil indicator or ratio type indicator, used to indicate directly the insulation resistance value and/or the null detection for bridge measurements.

2.8 Scale Length — The length of the arc through the tips of the shortest scale mark. In case of multiscale instrument the scale length shall correspond to the longest of all scales.

2.9 Type Tests — Tests carried out to prove conformity with the requirements of this standard. These are intended to prove the general quantities and design of a given type of tester.

2.10 Routine Tests — Tests carried out on each tester to check requirements likely to vary during production.

2.11 Acceptance Tests — Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

3. RATINGS

3.1 The rated voltage and rated insulation resistance may be selected from the values shown in Table 1.

TABLE 1 RATING OF INSULATION RESISTANCE TESTERS

Rated Voltage (dc Volts)	100			250			500			1 000		
Rated Insulation Resistance (MΩ)	10	20	200	20	50	500	20	100	1 000	200	500	2 000

3.2 The measurable resistance (Wheat stone Bridge) shall be at least from 0·01 ohm to 1·0M ohm in five overlapping ranges.

4. CONSTRUCTION

4.1 General — The tester shall be sufficiently robust to withstand mechanical vibrations and shocks. Its working parts shall be housed in a case which shall be dust-proof and of sufficient strength to afford adequate protection against external damage. It shall withstand vibration test (**11.9**) and bump test (**11.10**).

4.2 Terminals — The following terminals shall be provided.

4.2.1 *Line Terminal* — The terminal marked *'L'* connected to the negative side of the generator.

4.2.2 *Earth Terminal* — The terminal marked *'E'* connected to the positive side of the generator.

4.2.3 *Varley Earth* — The terminal marked *'EV'* for the purpose of varley fault test.

4.2.4 *Guard Terminal* — The tester shall be equipped with guard ring around the line terminal. A guard terminal shall also be provided and electrically connected to the guard ring in case of testers having rated resistance of 1 000 MΩ and above

NOTE 1 — The line terminal, guard ring and guard terminal shall be connected to the negative side and the earth terminal to the positive side of the generator.

NOTE 2 — The line terminal, guard ring and earth terminal shall be suitably marked, preferably as *L*, *G* and *E* respectively to distinguish them.

NOTE 3 — More suitably marked terminals may be provided to serve as *I*, *II* and *EV* for bridge measurements.

4.3 Switches

4.3.1 *Selector Switch* — A rotary selector switch for selecting the functions of 'Insulation test', 'Loop resistance test' and 'Varley fault test' shall be provided and suitably marked. Additional functions, such as discharge continuity and murray loop test may be provided in the same selector switch.

4.3.2 *Ratio Multiplier Switch* — For bridge measurement a rotary ratio multiplier switch with at least five multiplier position, namely, X 0·01, X 0·1, X 1, X 10 & X 100, suitably marked, shall be provided.

4.3.3 *Series Resistance Switches* — Rotary switches and/or potentiometer shall be provided for selecting any value between 1 to 9 999 ohms or more in the arms of the wheatstone bridge, which should be indicated suitably.

4.3.4 *Resistors* — The coils of the ratio and series switches shall be non-inductively wound on non-magnetic spools. The accuracy of the resitors shall be within ±0·5 percent of their nominal value at 27°C.

4.4 Infinity/Zero Adjustment — A suitable device shall be provided to adjust the pointer to 'infinity' in case of ratio-type instruments having rated resistance of 1 000 MΩ and above. For single coil instruments, suitable device shall be provided for adjusting both zero and infinity.

4.5 Pointer

4.5.1 The pointers shall be light and rigid and so shaped as to lend itself to easy and accurate reading.

4.5.2 The pointer shall have a knife-edge tip and shall extend over the whole length of the short scale-marks, but not appreciably beyond them.

4.5.3 The thickness of the pointer knife-edge shall not exceed 0·30 mm.

4.5.4 The knife-edge of the poiter shall be coloured red on the top-edge.

4.6 Central Scale Mark — When the scale starts from 0 MΩ the central scale mark in the insulation range shall be located approximately in the geometrical centre of the effective range.

5. EFFECTIVE RANGE

5.1 The effective insulation indicator range shall be from the rated insulation resistance down to the one-thousandth of the rated insulation resistance.

6. ROTATION SPEED

6.1 The rated speed of rotation of the handle at which the rated terminal voltage is attained shall not exceed 160 rev/min.

It shall be ensured that the terminal voltage is within the tolerance specified in **9.2** even when the rotation speed of the handle exceeds these values.

7. GENERAL REQUIREMENTS

7.1 Operation of the Tester

7.1.1 The handle of the tester shall work smoothly. It shall preferably fold back into the casing when the tester is not in use.

7.1.2 The friction in the generator system of the tester shall be as small as practicable.

7.1.3 The degree of camping of the moving coil sytem of the tester, that is, the time elapsed till the pointer has been brought to standstill, when a resistance of the value corresponding to the central scale mark of the insulation range is inserted between the measuring terminals under the normal conditions of use as insulation tester shall not exceed three seconds.

8. NORMAL CONDITIONS OF USE

8.1 The tester shall be used on horizontal surface, with handle rotating at the rated speed or above. The external magnetic field at the place should be less than that specified in **11.4.5**.

9. LIMITS OF ERROR

9.1 Insulation Range — The deviation of the pointer from the true value marked shall be within ±5 percent in the first effective range and ±10 percent in the second effective range. The deviation of the pointer at 1/10 of the rated resistance shall be within ±5 percent. The deviation of the pointer at the infinity and zero or minimum value shall not exceed ±0·7 percent of the scale length.

9.2 Terminal Voltage — With the selector switch in 'Insulation' position, the terminal voltage, from rated speed up to and including 150 percent of the rated speed of rotation marked on the tester shall be:

a) within ±10 percent of rated voltage corresponding to the rated resistance, and

b) not less than 90 percent of rated voltage for the central scale mark.

9.3 Resistance (Wheatstone) Bridge Range — The deviation of readings obtained on the wheatstone bridge shall be within the following limits.

Range	*Limit*
0·1 Ω to 1 Ω	±10 percent
1·0 Ω to 10 Ω	±2 percent
10 Ω to 100 KΩ	±1 percent
100 KΩ to 1 MΩ	±2 percent

9.4 It should be possible to locate faults with accuracy, given in **9.3** with fault resistance up to 1 MΩ.

10. MARKING

10.1 The following particulars shall be indelibly and suitably marked on the tester either on the dial, or the back or sides or in the cover or on the instruction sheet of the instrument, and shall be visible without necessity of opening the instrument:

a) Serial number and model number of the tester,

b) Rated voltage and rated insulation resistance,

c) Speed of rotation,

d) Manufacturer's name and/or trade-mark,

e) Country of manufacture,

f) Symbol 'OADJ' and 'α ADJ' for devices used for controlling the magnetic shunt or adjusting resistance, and

g) Brief instructions for using the tester and precaution to be taken at the time of using the instrument, and at the time of storing.

10.2 The circuit diagram along with detailed component list shall be provided in the instruction manual.

10.3 The bridge insulation resistance tester may also be marked with Standard Mark.

10.3.1 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

11. TESTS

11.0 General — Tests shall be carried out unless otherwise specified at the standard temperature of 27 ± 2°C and relative humidity of 65 ± 5 percent.

11.1 Type Tests — The following shall constitute the type tests:

a) Tests for limits of error (**11.4.1** to **11.4.6**),
b) Mechanical endurance test (**11.5**),
c) Insulation resistance test (**11.6**),
d) High voltage test (**11.7**),
e) Dust test (**11.8**),
f) Vibration test (**11.9**),
g) Bump test (**11.10**), and
h) Temperature cycle test (**11.11**).

11.2 Acceptance Tests — The following shall constitute the acceptance tests:

a) Insulation resistance test (**11.6**),
b) High voltage test (**11.7**),
c) Test for limits of error (**11.4.1**), and
d) Bump test (**11.10**).

11.3 Routine Test — The following shall constitute the routine tests:

a) Insulation resistance test (**11.6**).
b) High voltage test (**11.7**), and
c) Test for limits of error (**11.4.1**).

11.4 Test for Limits of Error

11.4.1 *Error at Reference Condition* — Tests shall be carried out at reference condition to prove conformity to the provisions laid down in **9.1**, **9.2**, **9.3** and **9.4**.

11.4.2 *Error Due to Variation of Level* — A change of 5 degrees in the level of the tester when used as insulation tester in any direction, shall not result in the deviation of the pointer from its initial position exceeding 0·5 mm.

11.4.3 *Error Due to Variation of Ambient Temperature* — The deviation of the indication of the tester shall not exceed ± 5 percent at the central scale mark for the ambient temperature change by $\pm 20°C$ from 27°C.

11.4.4 *Error Due to Excessive Humidity* — The error of the tester shall not exceed the limits specified in **9** after an exposure of 24 hours to a relative humidity of 90 percent and at a temperature of $27 \pm 2°C$. Recovery time shall be 24 h.

11.4.5 *Error Due to Stray Field* — The error of the tester at the Central Scale Mark shall not exceed ± 5 percent of the indicated value, when the tester is exposed to a magnetic field produced by 400 ampere-turns (do) in a coil of one metre diameter. The tester shall be so placed as to make the influence of the field maximum.

11.4.6 *Ripple at Measuring Terminal* — The ripple factor at the measuring terminal for the insulation measuring range, shall not exceed 10 percent.

11.5 Mechanical Endurance Test

11.5.1 After repetition of the starting (up to rated speed) stopping the generator for 10 000 times, there shall be no evident deterioration and impairment in the working of the tester and it shall satisfy the test specified in **9.3**. The ON and OFF times shall be at least 3 s and 6 s respectively and in any case time for 1 cycle shall not exceed 12 s.

11.5.2 All switch contacts shall be tested by actual operation of the switches 10 000 times. After 10 000 operations, there shall be no mechanical deterioration in the working of the switch and the apparatus shall satisfy the accuracy given in **9.3**.

11.6 Insulation Resistance Test — The insulation resistance of the tester across the electrical circuit and the containing case and across the electrical circuit and the handle, when measured by applying 500 V dc, shall be not less than the values given below:

a) For rated voltage up to and including 250 V	25 MΩ
b) For rated voltage above 250 V	50 MΩ

The voltage shall be applied for a duration long enough to get a steady reading of the insulation resistance.

11.7 High Voltage Test — No breakdown, arcing or sparking shall occur when an rms voltage of 2 000 volts is applied between all the electrical circuit connected together and the case or the handle for a period of 1 minute.

11.8 Dust Test

11.8.1 The chamber for this test shall be capable of maintaining in any region inside it, where the tester may be placed, temperature of 40 ± 2°C and a relative humidity of not more than 80 percent.

11.8.2 The atmosphere within the chamber shall be agitated so as to keep it loaded with dust particles of such a size as to enable them to pass through a wire mesh IS Sieve 150 — micron with an aperture of 0·15 mm [*see* IS : 460 (Part 1)-1978*]. The bulk of the material of the dust shall consist of free silice. The concentration of dust shall be determined by means of the device described in Appendix A where the requirment of dust concentration is also specified.

11.8.3 The tester shall be placed in the test chamber for four hours with the atmosphere stirred and the dust shall then be allowed to settle for two hours. The tester shall then be removed from the chamber and shall satisfy the requirements of **9**.

11.9 Vibration Test

11.9.1 The vibration test shall be carried out in accordance with IS : 9000 (Part 8)-1981†. The vibration severities shall be as given below:

Sweep Frequency Range Hz	*Amplitude*	*Duration* h	*Endurance Procedure*
10 — 150 — 10	0·15 mm (2 g)	6	Endurance at resonance frequency in most unfavourable direction. If direction is not known, vibration shall be applied for 2 h in each of the three mutually perpendicular directions. If no resonance is observed, the equipment shall be subjected to vibration sweep at the rate of 1 octave/minute for 2 h along each of the 3 mutually perpendicular axes.

*Specification for test sieve: Part 1 Wire cloth test sieves (*second revision*).

†Basic environmental testing procedures for electronic and electrical items: Part 8 Vibration (sinusoidal) test.

11.9.2 The following other requirements shall also be applicable:

a) Axis of vibration : Three mutually perpendicular axes.

b) Method of mounting : Normal operations attitude with anti-vibration mountings if provided.

c) Functional check : Need not be functioning.

d) Resonance search : The resonance frequency shall be found by sweeping the frequency over the range selected from the table above. After resonance search, the instrument shall comply with the requirements of **9**.

e) Endurance : The instrument shall be subjected to the endurance as specified in the table above. After completion of the endurance, the instrument shall be checked to comply with the requirements of **9**.

11.9.3 After this test, the tester shall satisfy the requirements given in **9**.

11.10 Bump Test — The error of the tester at the central scale mark shall not deviate by more than ±5 percent from the initial value when subjected to Bump Test as specified in IS : 9000 (Part 7/Sec 2)-1979* with the following severities:

Number of bumps	:	4 000 ± 10
Repetition rate	:	2 to 3 bumps
Duration of pulse	:	6 ms
Peak acceleration	:	400 m/s^2
Velocity change	:	1·53 m/s (tolerance ± 20 percent)

11.11 Temperature Cycle Test — The tester shall operate without incurring permanent damage and also satisfy the requirements of **9** when subjected the temperature cycle for 16 + 8 h cycle as given in **5.1** of IS : 1248 (Part 9)-1983† for temperature cycle limits −10°C to +55°C.

*Basic environmental testing procedures for electronic and electrical items: Part 7 Impact test, Section 2 Bump.

†Specification for direct acting electrical indicating instruments: Part 9 Test methods.

APPENDIX A

(*Clause* 11.8.2)

DUST CHAMBER AND APPARATUS FOR MEASURING DUST CONCENTRATION

A-1. DUST CHAMBER

A-1.1 A schematic layout of a typical chamber recommended for use for the dust cycle is shown in Fig. 1. It is designed to ensure uniform and reproducible distribution of dust. The system is completely enclosed and does not become congested during operation. A circulating fan *F* (low pressure, high volume, ventilating pattern) blows air over the pile *P* where the dust is picked up and carried along into the chamber *C*. The air velocity decreases in the chamber so that much of the dust falls back into the hopper *H* from where it returns to the pile, while the air is fed back into the fan through the top of the chamber. The dimensions of the hopper tube are so proportioned that whatever the head of the dust pressure may be, the pile *P* never completely fills the main air duct. Consequently, the air flow carries away, more or less, a constant amount of dust from a pile which all the time is being replenished.

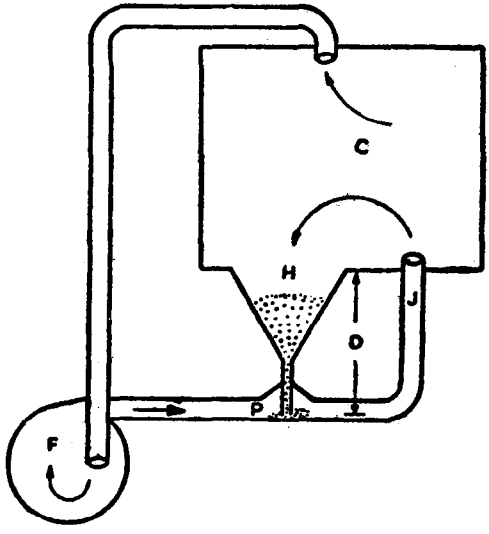
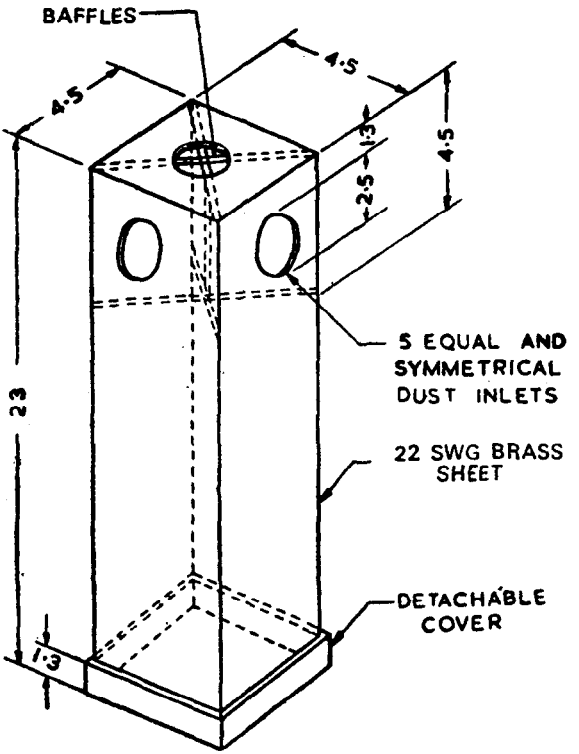


FIG. 1 SCHEMATIC LAYOUT OF APPARATUS USED FOR THE DUST CYCLE



All dimensions in millimetres.

FIG. 2 DETAILS OF APPARATUS FOR MEASURING DUST CONCENTRATION

A-1.2 The arrangement described under **A-1.1** may be modified so as to result in a flow of dust loaded air which takes the shape of a rising vertex. For this purpose, four dust jets may be used in a symmetrical configuration.

A-1.3 The more important details of a typical dust chamber are given below:

a) Internal size of chamber	91·5 cm cube
b) Heater rating	750 watts
c) Fan rating	7 100 litres/min at a pressure of 3·8 cm H_2O 250-watt, 3 000 rev/min motor

d) Inside diameter of hopper pipe 2·54 cm

e) Inside diameter of circulating dust 12·7 cm

A-2. APPARATUS FOR MEASURING DUST CONCENTRATION

A-2.1 A simple measuring device is shown in Fig. 2. Dust enters the box through the five circular holes and collects at the bottom of the detachable cover. For measuring dust concentration, the device is placed in any representative position within the dust chamber. The air is circulated for five minutes and the dust is then allowed to settle down. The amount of dust which collects on the detachable cover during the total test period is weighed and shall be 23 $\pm$ 25 g.

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Printed at Dee Kay Printers, New Delhi, India