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Draft Indian Standard

SPECIFICATION FOR MOVING COIL VOLTAGE REGULATORS
(First Revision)

Last date of comments: 03-08-2024

FOREWORD

(Formal Clauses will be added later)

This Indian Standard was adopted by the Indian Standards Institution on 28 April 1982, after the draft finalized by the Transformers Sectional Committee had been approved by the Electrotechnical Division Council.

Moving coil voltage regulators are extensively used either to get the constant output voltage with a variable range of input voltage or to get variable output voltage with a constant input voltage depending on their design.

The harmonics and wave-form distortion introduced by the use of this type of regulators may be taken care of by the user, if required.

This standard is to be read in conjunction with IS 2026 (Part 1): 2011-Power transformers: Part 1 General (Second Revision), IS 2026 (Part 2): 2010-Power Transformers Part 2 Temperature-Rise (First Revision), IS 2026 (Part 3):2018- Power Transformers: Part 3 Insulation levels, Dielectric Tests and External Clearances in air (Fourth Revision), and IS 2026 (Part 4): 1977-Specification for Power Transformers: Part 4 Terminal Markings, Tappings and Connections (First Revision). Should, however, any deviation exist between the requirements of IS 2026 (Part 1): 2011, IS 2026 (Part 2): 2010, IS 2026 (Part 3): 2018, IS 2026 (Part 4): 1977 and those of this standard, the provision of the latter shall apply.

This standard is being revised again to keep pace with the latest technological developments and international practices. In this revision, the following major changes have been made:

- a) A reference clause has been added mentioning the latest version of all the referred standards.
- b) Editorial corrections have been done.

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: 2022 Rules for Rounding off Numerical Values (Second Revision). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1 SCOPE

1.1 This standard covers the requirements and methods of tests for moving coil voltage regulators of voltage ratings up to and including 33 kV.

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards:

<i>IS No.</i>	<i>Title</i>
IS 1885 (Part 38): 1993	Electrotechnical vocabulary Part 38 Power transformers and reactors (Second Revision)
IS: 2026 (Part 1): 2011	Power transformers: Part 1 General (Second Revision)
IS 2026 (Part 2): 2010	Power transformers: Part 2 Temperature - Rise (First Revision)
IS: 2026 (Part 3): 2018	Power transformers: Part 3 insulation levels, dielectric tests and external clearances in air (Fourth Revision)
IS: 2026 (Part 4): 1977	Specification for Power Transformers: Part 4 terminal markings, tappings and connections (First Revision)

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 1885 (Part 38): 1993 in addition to the following shall apply.

3.1 Moving Coil Voltage Regulator (MCVR) — A piece of apparatus with one short-circuited moving coil which offers buck or boost to the applied voltage by moving the position of the coil.

3.2 Dry Type MCVR — MCVR having the core and windings directly exposed to air or to a gas substantially at atmospheric pressure.

3.3 Oil Immersed MCVR — MCVR having the core and windings immersed in a mineral oil.

3.4 Fixed Coil — A coil which receives the input voltage and is stationary.

3.5 Booster Coil — A coil connected to the fixed coil in such a way that it gives boost to the input voltage.

3.6 Buck Coil — A coil connected to the fixed coil in such a way that it gives buck to the input voltage.

3.7 Moving Coil — A short-circuited coil which is free to move up and down along the axis of the core and fixed coils.

3.8 Manually Operated MCVR — MCVR in which the moving coil is moved with an external handle or other suitable arrangement, including power assisted drive.

3.9 Automatically Operated MCVR — MCVR in which movement of moving coil is automatically controlled to give designed output voltage or the range of voltages.

3.10 Rated Input Voltage — Constant or variable no-load input voltage specified for the MCVR.

3.11 Rated Output Voltage — Constant or variable no-load output voltage specified for the MCVR.

3.12 Rated Current — Maximum continuous full load current which a winding is assigned to carry.

3.13 Rated kVA — The product of rated constant voltage, rated current and the appropriate phase factor.

NOTES —

- a. Rated constant voltage shall be either rated input or rated output voltage whichever is specified as constant and the rated current shall be the current assigned to the rated constant voltage winding.
- b. Phase factors for single and three phase supply are 1 and 1.73 respectively.

4 COOLING

4.1 The methods of cooling employed and their identification shall be in accordance with 3 of IS 2026 (Part 2): 2010.

5 SERVICE CONDITIONS

5.1 The provisions of 1.1 of IS 2026 (Part 1): 2011 and 4 of IS 2026 (Part 2):2010 shall be applicable.

6 RATINGS

6.1 Rated kVA — The provisions of 4 of IS 2026 (Part 1): 2011 shall be applicable.

6.2 Rated Voltage — Rated voltage shall be as specified by the purchaser.

6.3 Rated Frequency — The rated frequency shall be 50 Hz.

7 CONSTRUCTION

7.1 MCVR shall have a suitable enclosure, which shall be provided with two independent earthing terminals.

7.2 In case of power assisted drive, provision may be made, when required by the user, for operation with external handle also. In such a case suitable inter-locking shall be provided with the power operating system to ensure the safety of the operator.

7.3 Fixed Coil — It shall consist of two sections wound on the same core, one above the other and connected in series opposition. It shall be concentric with the moving coil and the core.

8 LIMITS OF TEMPERATURE RISE

8.1 The temperature rises of the MCVR winding and core shall be in accordance with 4 of IS 2026 (Part 2): 2010

9 INSULATION LEVELS

9.1 The insulation levels and corresponding test voltages shall be in accordance with Table 1.

10 TERMINAL MARKING AND RATING PLATE

10.1 The input and output terminals shall be marked in accordance with IS 2026 (Part 4):1977.

TABLE 1 INSULATION LEVELS AND TEST VOLTAGES

(Clause 9.1)

HIGHEST SPECIFIED VOLTAGE (INPUT OR OUTPUT)	IMPULSE TEST VOLTAGE (1-2/50 μs Wave Shape)	POWER FREQUENCY TEST VOLTAGE (WITHSTAND VALUE FOR 1 min)
(1)	(2)	(3)
kV	kV peak	kV
Less than 1.1	-	2.5
1.1	-	3
3.6	40	10
7.2	60	20
12	75	28
17.5	95	38
24	125	50
36	170	70

NOTE — Moving coil shall not be subjected to the above tests as its terminals are not brought out.

10.2 Each MCVR shall be provided with a rating plate of weatherproof material, fitted in a visible position showing the information given in **10.3**. The entries on the rating plate shall be indelibly marked (for example by etching, engraving or stamping).

10.3 Rating Plate — The information to be given on the rating plate shall be as under:

- a) Name of equipment, namely, moving coil voltage regulator;
- b) Number of this standard, Ref IS 10161;
- c) Manufacturer's name;
- d) Manufacturer's serial number;
- e) Number of phases;
- f) Year of manufacture;
- g) Rated kVA;
- h) Rated frequency;
- j) Rated input voltage with range as applicable;
- k) Rated output voltage with range as applicable;
- m) Rated input and rated output current;
- n) Type of cooling;
- p) Total mass; and
- q) Mass and volume of insulating oil.

10.3.1 The following information relevant to control motors shall also be given to the extent applicable:

- a) Rated kW,
- b) Rated voltage,
- c) Type of supply, and
- d) Number of phases.

10.4 Moving Coil Voltage Regulators may also be marked with the Standard Mark.

The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 2016 and the Rules and Regulations made thereunder. The details of conditions under which the license for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

11. FITTINGS

11.1 The information on Fittings provided with MCVR shall be as per Annex B of IS 2026(Part 1): 2011 with the exception that providing dehydrating breather and conservator shall be optional for all ratings.

12. TOLERANCES

12.1 Unless otherwise specified, the tolerances on the declared values shall be in accordance with Table 1 of IS 2026 (Part 1):2011.

13. TESTS

Unless otherwise mentioned in this standard, the tests shall be carried out in accordance with the test methods specified in IS 2026 (Part 1): 2011, IS 2026 (Part 2): 2010, and IS 2026 (Part 3): 2018 as applicable.

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

- a) Measurement of winding resistance;
- b) No-load voltage and no-load current at maximum and minimum positions (**13.3**);
- c) Measurement of no-load loss at maximum and minimum positions;
- d) Measurement of load-loss and impedance voltage at the maximum and minimum positions,
- e) Measurement of insulation resistance;
- f) Induced over-voltage withstand test with moving coil at maximum and minimum positions;
- g) Separate source voltage withstand test;
- h) Temperature rise test at maximum loss position;
- j) Lightning Impulse test;
- k) Rate of correction of voltage (applicable to automatic MCVR only) (**13.4**); and
- m) Test for continuous operation (applicable to automatic MCVR only) (**13.5**).

13.1.1 For type tests, the number of samples of MCVR of same rating, design and type shall be as given below:

kVA Rating	Number of Samples
up to 10	2
Above 10	1

Sample(s) shall pass all the tests mentioned in **13.1** for proving conformity to the requirements of this standard. If any of the samples fail(s) in any of the type tests, testing authority, at its discretion, may call for fresh samples not exceeding twice the original number and subject them again to all the tests in which failure had occurred. No single failure shall be permitted in the repeat test(s).

13.2 Routine Tests — The following shall comprise the routine tests:

- a) Measurement of winding resistance,
- b) No-load voltage and no-load current at maximum and minimum positions (**13.3**)
- c) Measurement of no-load loss in maximum and minimum positions,
- d) Measurement of load loss and impedance voltage,
- e) Measurement of insulation resistance,
- f) Induced over-voltage withstand test with moving coil in maximum and minimum positions, and
- g) Separate source voltage withstand test.

13.3 No-load Voltages and No-load Current at Maximum and Minimum Positions.

13.3.1 In case of MCVR suitable for giving constant output voltage, the input voltage shall be varied from minimum to maximum as given on the rating plate. For manually operated MCVR, unless otherwise specified

by the purchaser, it shall be possible to get the rated voltage when the input voltage remains within the specified voltage. For automatically operated MCVR, the output voltage shall remain within ± 2 percent of the rated voltage.

13.3.2 For MCVR designed to give variable output voltage, the rated voltage shall be applied to the input terminals and the positions of the coil shall be varied from minimum to maximum.

MCVR shall be capable of giving the specified voltage range.

NOTE — Ratio measurement may be used wherever appropriate to show that the required range of voltages is met at no load.

13.3.3 The values of no-load current shall be noted down at the minimum and maximum positions of the no-load voltages. The no-load current shall not be more than 20 percent of the specified full load current for these positions.

13.4 Rate of Correction of Voltage — Time taken for the moving coil to move from one position to the other to give the requisite voltage range from minimum to maximum shall be noted. The voltage range divided by the time so taken shall be taken as the rate of correction of voltage. The test shall be repeated for positions from highest to the lowest voltage range. The value for rate of correction of voltage shall be as agreed between the purchaser and the supplier.

13.5 Test for Continuous Operation — MCVR shall be subjected to a continuous run for a period of one hour, the voltage being changed from one end to the other at the rate of correction of voltage as obtained in 13.4. After this period, measurement of insulation resistance and no-load voltage test shall be repeated.