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Neposredni kazalni analogni električni merilni instrumenti in njihov pribor – 9. del: Priporočene preskusne metode (IEC 60051-9:1988)

Direct acting indicating analogue electrical measuring instruments and their accessories - Part 9: Recommended test methods (IEC 51-9:1988)

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ENGLISH VERSION

DIRECT ACTING INDICATING ANALOGUE ELECTRICAL MEASURING INSTRUMENTS AND THEIR ACCESSORIES PART 9: RECOMMENDED TEST METHODS (IEC 51-9 (1988) edition 4)

Appareils mesureurs électriques indicateurs analogiques à action directe et leurs accessoires Neuvième partie: Méthodes d'essais recommandées (CEI 51-9 (1988) édition 4)

Direkt wirkende anzeigende elektrische Meßgeräte und ihr Zubehör Meßgeräte mit Skalenanzeige Teil 9: Empfohlene Prüfverfahren (IEC 51-9 (1988) Ausgabe 4)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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BRIEF HISTORY

The text of IEC-Publication 51-9 (4th edition - 1988) was submitted to the CENELEC members for unique acceptance.

TECHNICAL TEXT

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Appareils mesureurs électriques indicateurs analogiques à action directe et leurs accessoires

Neuvième partie:
Méthodes d'essai recommandées

Direct acting indicating analogue electrical measuring instruments and their accessories

Part 9:
Recommended test methods

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

DIRECT ACTING INDICATING ANALOGUE ELECTRICAL MEASURING INSTRUMENTS AND THEIR ACCESSORIES

Part 9: Recommended test methods

FOREWORD

1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.

2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.

3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This standard has been prepared by IEC Technical Committee No. 85: Measuring equipment for basic electrical quantities (former Sub-Committee 13B: Electrical measuring instruments).

This fourth edition replaces the third edition of IEC Publication 51.

This standard constitutes Part 9.

The general layout for the revised Publication 51 is as follows:

Part 1: Definitions and general requirements common to all parts.

Part 2: Special requirements for ammeters and voltmeters.

Part 3: Special requirements for wattmeters and varmeters.

Part 4: Special requirements for frequency meters.

Part 5: Special requirements for phase meters, power factor meters and synchroscopes.

Part 6: Special requirements for ohmmeters (impedance meters) and conductance meters.

Part 7: Special requirements for multi-function instruments.

Part 8: Special requirements for accessories.

Part 9: Recommended test methods.

Part 9 is not complete in itself as it contains no requirements. The requirements are contained in Parts 1 to 8 and include references to the test sub-clauses of Part 9.

Three tests specified in Part 9 have no corresponding requirements in Parts 1 to 8 but are included to permit standardization of the test methods for characteristics that are normally specified by agreement between the manufacturer and the user. These tests are:

- Pull-in difference frequency
- Tracking error
- Simultaneous influence of voltage and power factor.

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

Six Months' Rule	Report on Voting
13B(CO)105	85(CO)5

Full information on the voting for the approval of this standard can be found in the Voting Report indicated in the above table.

DIRECT ACTING INDICATING ANALOGUE ELECTRICAL MEASURING INSTRUMENTS AND THEIR ACCESSORIES

Part 9: Recommended test methods

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1. Scope and general test conditions

1.1 *Scope*

Part 9 of Publication 51 contains recommended test methods for direct acting indicating analogue electrical measuring instruments and their accessories.

1.2 *General test conditions*

The test methods described in this part shall be applied under the following conditions unless otherwise specified.

1.2.1 *Reference conditions*

Reference conditions shall be according to Table I of the relevant part. Where a reference range is specified, tests shall be performed at both limits of the reference range.

1.2.2 *Parallax*

Note.- Care should be taken to avoid the effect of parallax error when taking instrument readings.

For an edgewise instrument, the line of vision should be perpendicular to the instrument dial at the index tip.

For an instrument having a mirror scale, the line of vision should be such that the index tip is coincident with its reflection in the mirror.

1.2.3 *Tapping*

Immediately prior to taking a reading, either the instrument or its support shall be tapped lightly as with a finger or the eraser end of a pencil.

However, tapping is not permitted in certain tests such as those for determining intrinsic error, return to zero and the effects of shock and vibration, as stated in these test methods.

1.2.4 *Thermal stability*

All instruments shall be allowed to remain at the reference temperature long enough to eliminate temperature gradients.

Note.- Two hours will usually be sufficient.

1.2.5 *Preconditioning time*

See Part 1: Sub-clause 3.3.1.

1.2.6 *Zero adjustment (mechanical)*

With the instrument disconnected from all supplies and before each set of readings is taken, the index shall be set on the zero scale mark or to an appropriate reference mark on the scale using the mechanical zero adjuster, as follows:

1) Operate the zero adjuster in a direction which will drive the index toward the zero mark of the instrument.

2) While continuing to drive the index in the direction selected in 1), set the index on the zero mark while tapping the instrument case. Once the direction of drive has been selected, do not change it until the index is on the zero mark.

3) With the index set on the zero mark, reverse the direction of motion of the zero adjuster, and drive it far enough to introduce mechanical freedom (play) in the zero adjuster, but not far enough to disturb the position of the index.

Exception: Instruments without zero adjuster or where the mechanical zero does not appear on scale shall not be reset.

1.2.7 *Zero adjustment (electrical)*

Before each set of readings, the index shall be set on the reference mark with the electrical zero adjuster. Refer to the manufacturer's instructions for details of this adjustment.

1.2.8 *Test equipment errors*

All tests shall be made using reference instruments having an intrinsic error no more than one-fourth of that corresponding to the accuracy class of the instrument under test. However, the use of reference instruments having an intrinsic error no more than one-tenth of that corresponding to the accuracy class of the instrument under test is strongly recommended.

When testing for variations avoid, if possible, applying the influence quantity (e.g. temperature) to the reference instrument. Otherwise, ensure that the reference instrument is not affected by more than one-fourth of the permissible variation of the instrument under test, where both are subjected to the same influence quantity (e.g. change of frequency).

Manufacturers shall make allowance for reference instrument uncertainty to ensure that all instruments are within their error limits at the time of shipment. In contrast, a user shall add the errors of his reference instrument to the permitted error when rechecking an instrument and the resulting sum shall be used for the limit for that test.

Nothing in these recommendations is intended to prevent the use of special test methods and/or specialized test equipment for making testing simpler and/or more accurate.

1.2.9 *Reading methods*

Whenever possible, tests shall be conducted by setting the instrument under test to a scale mark and reading the reference instrument.

Note.- The reference instrument should have an adequate scale resolution (or number of digits) to enable readings to be taken with a resolution at least as good as that corresponding to one-fifth of the accuracy class of the instrument under test.

1.2.10 *Polyphase testing*

Polyphase instruments may be tested by connecting to an appropriate polyphase supply with properly measured and controlled voltages, currents and phase angles.

If single-phase testing of polyphase instruments is permitted by the manufacturer, the current coils may be connected in series and the voltage coils in parallel. In all cases, follow the manufacturer's instructions for details of connections and the application of calibration constants.

1.2.11 *A.C. instrument testing on d.c.*

Some a.c. instruments, for example electrodynamic, thermal or electrostatic instruments, may be tested on d.c. if permitted by the manufacturer. If this is the case, perform the tests as specified for the instrument but use a d.c. supply and neglect references to power factor and phase angle. For these cases, the errors are computed from the average of the results from testing with the reversal of polarity of each measuring circuit. Other tests relating to a.c. variations may not apply.

1.2.12 *Multirange and multifunction instruments*

All ranges and all functions shall be tested separately. Instruments with multiple supply voltage capability shall be tested separately on each supply connection.

1.2.13 *Test leads*

If test leads are specified by the manufacturer they shall be used for these tests. Otherwise, the size and placement of leads used in the performance of these tests shall be such that they do not influence the test results.

1.2.14 *Ohmmeter testing*

For high value test resistors, the insulation of the test leads shall be adequate to ensure that the test resistor is not shunted to cause errors greater than one-tenth of the rated intrinsic error of the ohmmeter.

For low value resistors, the total resistance of the test leads shall be allowed for unless it is negligible in comparison with the value of the test resistor.

Ohmmeters having special leads terminating in spikes may need special test resistors having terminals capable of accepting the spikes.

Ohmmeters measuring the values of 4-terminal resistors may need special test resistors.

Care shall be taken when testing high voltage ohmmeters that the voltage rating of the test resistor is not exceeded. This is necessary both because of the danger of insulation breakdown and because of the possibility of the test resistor having a significant voltage coefficient.

If an ohmmeter has a stated value of test voltage when measuring a stated value of test resistance (or an open circuit), the voltage should be measured using a voltmeter having a permissible error not exceeding 1% of the test voltage. Where the voltage is to be measured at a definite value of test resistance, the voltmeter may be shunted to obtain this value. An electrostatic voltmeter, when shown to be adequately free from leakage, will be suitable for carrying out the open circuit voltage test.

Note.- An electronic d.c. voltmeter may be used but care should be taken to avoid the effects of input offset voltage and current.

Care shall be taken that the test resistor will not be damaged by the current supplied by the ohmmeter.

When an ohmmeter has a hand-driven generator, it should be turned, as nearly as possible, at a uniform speed and at the speed stated by the manufacturer. If a slipping clutch is provided, the turning speed should be about 10% higher than the clutch slipping speed.

2. Intrinsic error tests

2.1 *Ammeters and voltmeters*

2.1.1 *Procedure*

1) If relevant, set zero with tapping.

2) Apply sufficient slowly increasing excitation to bring the index sequentially to each of at least five approximately equidistant scale marks (B_X) including the lower and upper limits of the measuring range without tapping. Record the values of excitation (B_R) as shown by the reference instrument.

3) Increase the excitation to 120% of the value corresponding to the upper limit of the measuring range or to cause the index to reach the upper limit of its travel, whichever is the less. Immediately and slowly reduce the excitation to bring the index sequentially to the same scale marks (B_X) as in step 2) without tapping. Record the values of excitation (B_R) as shown by the reference instrument.

Note.- For instruments in which the zero is displaced within the scale, these tests should be performed on both sides of the zero scale mark as appropriate.

2.1.2 *Computation*

The intrinsic error, expressed as a percentage, shall be computed for each selected scale mark as follows:

$$\left(\frac{B_X - B_R}{A_F}\right) \times 100$$

where A_F is the fiducial value

2.2 *Wattmeters and varmeters*

2.2.1 *Procedure*

1) If relevant, set zero with tapping.

2) Energize the voltage circuits at rated voltage within ±2%.

3) Apply sufficient slowly increasing current to bring the index sequentially to each of at least five approximately equidistant scale marks (B_X) including the lower and upper limits of the measuring range without tapping. Record the values of excitation (B_R) as shown by the reference instrument.

4) Increase the current to 120% of the value corresponding to the upper limit of the measuring range or to cause the index to reach the upper limit of its travel, whichever is the less. Immediately and slowly reduce the current to bring the index sequentially to the same scale marks (B_X) as in step 3) without tapping. Record the values of excitation (B_R) as shown by the reference instrument.

Note.- For instruments in which the zero is displaced within the scale, these tests should be performed on both sides of the zero scale mark as appropriate.

2.2.2 *Computation*

The intrinsic error, expressed as a percentage, shall be computed for each selected scale mark as follows:

$$\left(\frac{B_X - B_R}{A_F}\right) \times 100$$

where A_F is the fiducial value

2.3 *Frequency meters (pointer type)*

2.3.1 *Procedure*

1) If relevant, set zero with tapping.

2) Apply rated voltage or a voltage at one of the limits of the reference range at a low frequency and slowly increase the frequency to bring the index sequentially to each of at least five approximately equidistant scale marks (B_X) including the lower and upper limits of the measuring range without tapping. Record the values of frequency (B_R) as shown by the reference instrument.

3) Increase the frequency to 120% of the value corresponding to the upper limit of the measuring range or to cause the index to reach the upper limit of its travel, whichever is the less. Immediately and slowly reduce the frequency to bring the index sequentially to the same scale marks (B_X) as in step 2) without tapping. Record the values of frequency (B_R) as shown by the reference instrument.

2.3.2 *Computation*

The intrinsic error, expressed as a percentage, shall be computed for each selected scale mark as follows:

$$\left(\frac{B_X - B_R}{A_F}\right) \times 100$$

where A_F is the fiducial value