BRITISH STANDARD

BS 89-3:1990
EN 60051-3: 1989
IEC 51-3:1984
Incorporating Amendment No. 1

Direct acting indicating analogue electrical measuring instruments and their accessories —

Part 3: Specification for special requirements for wattmeters and varmeters

This European Standard EN 60051-3 has the status of a British Standard

UDC 621.317.784.037.33

Cooperating organizations

The European Committee for Electrotechnical Standardization (CENELEC), under whose supervision this European Standard was prepared, comprises the National Committees of the following countries.

Austria	Italy
Belgium	Luxemburg
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Finland	Norway
France	Portugal
Germany	Spain
Greece	Sweden
Iceland	Switzerland
Ireland	United Kingdom

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Amendments issued since publication

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8749	August 1995	Indicated by a sideline in the margin

Contents

National foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee and is the English language version of EN 60051-3 "*Direct acting indication analogue electrical measuring instruments and their accessories — Part 3: Special requirements for wattmeters and varmeters*", including Amendment A1 published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical to the English language version of IEC Publication 51-3 published by the International Electrotechnical Commission (IEC) as amended by the editorial corrections listed in the technical text source on page 2.

For the purposes of this British Standard, any references to the IEC page numbers in the text should be ignored.

In 1995 the European Committee for Electrotechnical Standardization (CENELEC) accepted Amendment 1:1994 to IEC 51-3:1984 as amendment A1:1995 to EN 60051-3:1989.

This Part of BS 89 together with Parts 1, 2, 4, 5, 6, 7, 8 and 9 of the standard supersedes BS 89:1977, which is withdrawn.

BS 89 comprises the following Parts, which will be the English language version of the listed European Standards.

European Standard	Corresponding Part of BS 89
EN 60051-1	Part 1 *Specification for definitions and general requirements common to all Parts*
EN 60051-2	Part 2 *Specification for special requirements for ammeters and voltmeters*
EN 60051-4	Part 4 *Specification for special requirements for frequency meters*
EN 60051-5	Part 5 *Specification for special requirements for phase meters, power factor meters and synchroscopes*
EN 60051-6	Part 6 *Specification for special requirements for ohmeters (impedance meters) and conductance meters*
EN 60051-7	Part 7 *Specification for special requirements for multi-function instruments*
EN 60051-8	Part 8 *Specification for special requirements for accessories*
EN 60051-9	Part 9 *Recommended test methods*

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 60051-3

November 1989

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UDC 621.317.784.037.33

Key words: Electrical measuring instruments; analogue indicating instruments; direct acting measuring instruments; accessories for electrical measuring instruments; wattmeters; varmeters

English version

Direct acting indicating analogue electrical measuring instruments and their accessories
Part 3: Special requirements for wattmeters and varmeters

(includes amendment A1:1995)
(IEC 51-3:1984 edition 4)

Appareils mesureurs électriques indicateurs analogiques à action directe et leurs accessoires
Troisième partie: Prescriptions particulières pour les wattmètres et les varmètres
(inclut l'amendement A1:1995)
(CEI 51-3:1984 édition 4)

Direkt wirkende anzeigende elektrische Meßgeräte und ihr Zubehör Meßgeräte mit Skalenanzeige
Teil 3: Spezielle Anforderungen für wirk- und Blindleistrungs — Meßgeräte
(enthält Änderungen A1:1995)
(IEC 51-3:1984 Ausgabe 4)

CENELEC

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

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Brief history

The text of IEC-Publication 51-3
(4th edition — 1984) was submitted to the CENELEC members for unique acceptance.

Technical text

The text of the International Standard IEC 51-3 (4th edition — 1984) was approved by CENELEC on 11 September 1989 as a European Standard with the following editorial correction to the English version:

Table II-3, note 2, paragraph a: delete the words "instrument" and "capability".

The following dates are applicable:

- latest date of announcement of the EN at national level (doa): 1990-03-01
- date of latest publication of a new harmonized standard (dop): 1990-09-01
- date of withdrawal of conflicting national standards (dow): 1990-09-01

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 (formerly Sub-Committee 13B: Electrical Measuring Instruments).

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

This standard constitutes Part 3.

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.*

Parts 2 to 9 are not complete in themselves and shall be read in conjunction with Part 1.

All of these parts are arranged in the same format and a standard relationship between subject and clause number is maintained throughout. In addition, tables, figures and appendices add a suffix to the part number in order to differentiate the parts. This re-arrangement will assist the reader of IEC Publication 51 to distinguish information relating to the different types of instruments.

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

Six Months' Rule	Report on Voting
13B(CO)95	13B(CO)102

Further information can be found in the Report on Voting indicated in the table above.

The following IEC publication is quoted in this standard:

Publication No. 185 (1966): Current Transformers.

Foreword to Amendment A1

The text of document 85(CO)63, future amendment 1 to IEC 51-3:1984, prepared by IEC TC 85, Measuring equipment for electromagnetic quantities, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 60051-3:1989 on 1994-10-04

The following dates were fixed:

— latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsment	(dop)	1994-10-01
— latest date by which the national standards conflicting with the amendment have to be withdrawn	(dow)	1995-10-01

For products which have complied with EN 60051-3:1989 before 1995-10-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2000-10-01.

Contents

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1 Scope

1.1 Part 3 of the standard applies to direct acting indicating wattmeters and varmeters having an analogue display.

NOTE For multifunction instruments, see Part 7.

1.2 This part also applies to non-interchangeable accessories (as defined in Sub-clause **2.1.15.3** of Part 1) used with wattmeters and varmeters.

1.3 to **1.8** See Part 1.

2 Definitions

See Part 1.

3 Description, classification and compliance

3.1 Description

Wattmeters and varmeters shall be described according to their method of operation as given in Sub-clause **2.2** of Part 1.

3.2 Classification

Wattmeters and varmeters shall be classified in one of the accuracy classes denoted by the following class indices:

0.05, 0.1, 0.2, 0.3, 0.5, 1, 1.5, 2, 2.5, 3, 5.

3.3 Compliance with the requirements of this standard

See Part 1.

4 Reference conditions and intrinsic errors

4.1 Reference conditions

4.1.1 The reference values of the influence quantities shall be as given in Table I-1 and Table I-3.

4.1.2 See Part 1.

4.1.3 Reference conditions different from those given in Table I-1 and Table I-3 may be specified, but they shall then be marked in accordance with Clause **8** of Part 1.

Table I-3 — Reference conditions and tolerances, additional to those given in Table I-1, for testing purposes

Influence quantity	Reference conditions unless otherwise marked		Tolerance permitted for testing purposes, applicable for a single reference value[a]
Voltage component of measured power	Rated voltage or any voltage within the reference range, if any		± 2 % of the rated value
Current component of the measured power	Any current up to the rated current or up to the upper limit of the reference range, if any		—
Frequency of voltage and current components of the measured power	Instruments using phase shifting devices	Reference frequency	± 0,1 % of the reference frequency
	Other instruments	45 Hz to 65 Hz	±2 % of the reference frequency
Power factor	Cos ϕ = 1 or rated cos ϕ[b]		0,01 lagging or leading ± 0,01
Phase balance (for polyphase instruments)	Symmetrical voltages and currents		[cd]

[a] This tolerance applies when a single reference value is specified in this table or is marked by the manufacturer. For a reference range, no tolerance is allowed.
[b] Sin ϕ for varmeters. Positive sign for lagging (inductive), negative sign for leading (capacitive).
[c] The difference between any two line-to-line voltages and between any two line-to-neutral voltages shall not exceed 1 % of the average (line-to-line and line-to-neutral voltages, respectively).
Each of the currents in the phases shall differ by not more than 1 % from the average of the currents.
The angles between each of the currents and the corresponding phase-to-neutral voltages shall differ by not more than 2°.
[d] Single-phase testing of polyphase instruments if acceptable if permitted by the manufacturer.

4.2 Limits of intrinsic error; fiducial value

See Part 1.

4.2.1 *Correspondence between intrinsic error and accuracy class*

See Part 1.

4.2.2 *Fiducial value*

The fiducial value for a wattmeter or varmeter corresponds to:

4.2.2.1 The upper limit of the measuring range for the following:

— instruments with the mechanical and/or electrical zero at one end of the scale;

— instruments with the mechanical zero outside the scale irrespective of the position of the electrical zero;

— instruments with the electrical zero outside the scale irrespective of the position of the mechanical zero.

The class index is marked using Symbol E-1 given in Table III-1 (see Clause **8** of Part 1).

4.2.2.2 The sum of the electrical values, irrespective of sign, corresponding to the two limits of the measuring range when both the mechanical and the electrical zeros are displaced within the scale.

The class index is marked using Symbol E-1 given in Table III-1 (see Clause **8** of Part 1).

4.2.2.3 The span for an instrument whose scale marks do not correspond directly to its electrical input quantity.

The class index is marked using Symbol E-10 given in Table III-1 (see Clause **8** of Part 1).

This does not apply to a wattmeter or varmeter designed to be used in conjunction with one or more shunt(s), series resistor(s) (impedance(s) or (an) instrument transformer(s). These instruments are treated in accordance with Sub-clauses **4.2.2.1** or **4.2.2.2** as appropriate.

5 Nominal range of use and variations

5.1 Nominal range of use

See Part 1 and Table II-3.

Table II-3 — Limits of the nominal range of use and permissible variations additional to those given in Table II-1

Influence quantity		Limits of the nominal range of use unless otherwise marked	Permissible variation expressed as a percentage of the class index	For the recommended tests, see Part 9, Sub-clause:
Distortion of a.c. voltage or current components of the measured power	Distortion factor	Instruments using phase shifting devices 5 %	100 %	**3.7.3**
		Other instruments 20 %		
	Peak factor[a]	1 to 3[b]	Under consideration	
Frequency of a.c. voltage and current components of the measured power	Instruments using phase shifting devices	Reference frequency ± 1 % or lower limit of reference range – 1 % and upper limit of reference range + 1 %	100 %	**3.8.1**
	Other instruments	Reference frequency ± 10 % or lower limit of reference range – 10 % and upper limit of reference range + 10 %		
Voltage component of the measured power		Reference voltage ± 15 % or lower limit of reference range – 15 % and upper limit of reference range + 15 %	100 %	**3.9.1**
Power factor for wattmeters	Class indices 0.3 and smaller	Any: lagging or leading	100 %	**3.10.1**
	Class indices 0.5 and greater	Phase angle 0° ... 60°[c] lagging (inductive)		
Power factor for varmeters	Class indices 0.3 and smaller	Any: lagging or leading	100 %	**3.10.2**
	Class indices 0.5 and greater	Phase angle 0° ... 60°[c] lagging (inductive)		
Phase balance (for polyphase instruments)		Disconnection of one current component of the measured power	200 %	**3.12.1**

See notes, page 8.

Table II-3 — Limits of the nominal range of use and permissible variations additional to those given in Table II-1

Influence quantity	Limits of the nominal range of use unless otherwise marked	Permissible variation expressed as a percentage of the class index			For the recommended tests, see Part 9, Sub-clause:
Interaction between measuring elements of polyphase instruments[d]	Disconnection of one voltage component of the measured power	200 %			**3.16**
Magnetic field of external origin	0.4 kA/m		Class indices 0.3 and smaller	Class indices 0.5 and greater	**3.5**
		Electrodynamic instruments if not astatic and/or not having a magnetic screen	3 % of the fiducial value[e]	6 % of the fiducial value[e]	
		Ferrodynamic instruments if not astatic and/or not having a magnetic screen	1.5 % of the fiducial value[e]	3 % of the fiducial value[e]	
		All other instruments	0.75 % of the fiducial value[e]	1.5 % of the fiducial value[e]	

[a] For instruments having electronic devices in their measuring circuits.

[b] The permissible variation due to a peak factor of other than $\sqrt{2}$ (corresponding to a sine wave) is included in the permissible variation due to distortion of the measured power. For instruments having a peak factor capability greater than 3, the manufacturer shall state:

a) The instrument peak factor capability producing a variation of 100 % of the class index.

b) The upper and lower limits of the frequency response (bandwidth) to 0.707 times the indication at the reference frequency.

c) The effective maximum rate of change of internal instrument a.c. amplifier response (slew rate), expressed in volts per second using appropriate S.I. prefixes.

Peak factor relates to the total peak factor capability of the instrument and includes both the peak factor due to a distorted waveform and the peak factor due to spurious impulses (which may be random or harmonically related to the fundamental frequency) containing negligible average power.

[c] Inductive power factor unless otherwise agreed between manufacturer and user.

[d] It may sometimes be impossible to carry out a test for interaction between the measuring elements due to interconnection of the current and/or voltage circuits.

[e] Not as a percentage of the class index.

5.2 Limits of variations

See Part 1 and Table II-3.

5.3 Conditions for the determination of variations

See Part 1.

5.4 Determination of variation due to power factor

The power factor shall be lagging for instruments of class indices 0.5 and greater. For instruments of class indices 0.3 and smaller, the test shall be carried out using both lagging and leading power factors.

5.5 Special tests for variations

Special tests using combinations of the components of the measured quantity may be carried out when considered necessary by agreement between manufacturer and user.

6 Further electrical and mechanical requirements

6.1 Voltage tests, insulation tests and other safety requirements

See Part 1.

6.1.1 For a fixed wattmeter or varmeter having the upper limit of its rated current range of 1 A to 10 A and intended for use with a current transformer having a high overcurrent capability (Class P transformers as specified in IEC Publication 185: Current Transformers), the current circuit shall not open when it is subjected to 30 times the nominal secondary current[1)] of the associated current transformer for a period of 2 s.

A portable wattmeter or varmeter intended for similar use shall withstand 15 times the upper limit of its current range for a period of 2 s.

These wattmeters and varmeters need not be functional after application of this overload, but the current circuit(s) shall not then be open.

For the recommended test, see Sub-clause **4.8** of Part 9.

6.2 Damping

See Part 1.

6.2.1 ***Overshoot***

See Part 1.

6.2.2 ***Response time***

See Part 1.

However, the requirements of Sub-clauses **6.2.1** and **6.2.2** of Part 1 do not apply to the following types of wattmeters and varmeters:

— thermal instruments;

— instruments having a freely suspended moving element;

— instruments having a material pointer longer than 150 mm;

— instruments in which the power (active or reactive) corresponding to the upper limit of the measuring range is less than 10 W or 10 var;

— special purpose instruments where other response times may be required. Such instruments will be the subject of agreement between manufacturer and user.

6.2.3 ***Impedance of the external measuring circuit***

See Part 1.

6.3 Self-heating

See Part 1.

6.4 Permissible overloads

6.4.1 ***Continuous overload***

For the recommended test, see Sub-clause **4.6** of Part 9.

Wattmeters and varmeters, together with their non-interchangeable accessory(ies), if any, except for instruments fitted with a non-locking switch, shall be subjected to a continuous overload of 120 % of the rated values of current and voltage sequentially, the other value being maintained at its rated value. The duration of each application shall be 2 h.

After having cooled to the reference temperature, the instrument together with its non-interchangeable accessory(ies), if any, shall comply with its accuracy requirements; however, the overload shall not be repeated.

The continuous overload test shall be carried out under reference conditions except for current and voltage. The power factor for wattmeters shall be $\cos \phi = 1$ and the power factor for varmeters shall be $\sin \phi = 1$.

[1)] IEC Publication 185 uses the term “rated current” for this concept.

Table IV-3 — Overloads of short duration

Current factor	Voltage factor	Number of overloads	Duration of each overloads (s)	Interval between successive overloads (s)
Class indices 0.5 and smaller				
1	2	1	5	—
2	1	5	0.5	15
Class indices 1 and greater				
10	1	9	0.5	60
10	1	1	5	—
1	2	I	5	—

NOTE When two or three series of tests are specified, all the tests should be carried out in the order given. The overloads of short duration are applied simultaneously to all the measuring elements of polyphase wattmeters and varmeters.

6.4.2 ***Overloads of short duration***

For the recommended test, see Sub-clause **4.4** of Part 9.

Wattmeters and varmeters, together with their non-interchangeable accessory(ies), if any, shall be subjected to overloads of short duration.

However, these requirements do not apply to:

— thermocouple instruments;

— instruments having a freely suspended moving element.

6.4.2.1 The values of current and voltage for the overloads of short duration shall be the product of the relevant factor given in Table IV-3 and the value of the upper limit of the nominal range of use for current and voltage unless other values are stated by the manufacturer. The power factor (reactive power factor) shall be at its reference value.

6.4.2.2 The full duration of each overload shall be applied except when an automatic cut-out (fuse) fitted to the instrument has interrupted the circuit in less than the time specified in Table IV-3.

The automatic cut-out shall be reset (or the fuse replaced) before the application of the next overload.

6.4.2.3 After having been subjected to the overloads of short duration and after having cooled to the reference temperature, wattmeters and varmeters whose mechanical zero is within the scale, together with their non-interchangeable accessory(ies), if any, shall comply with both of the following requirements:

1) the deviation of the index from the zero scale mark, expressed as a percentage of the scale length, shall not exceed the following value:

a) 0.5 for instruments of class indices 0.5 and smaller,

b) the class index for instruments of class indices 1 and greater;

2) the wattmeter or varmeter, together with its non-interchangeable accessory(ies), if any, after adjustment of the zero (if necessary) shall comply with the accuracy requirements; however, the overloads shall not be repeated.

A wattmeter or varmeter whose mechanical zero is outside the scale is considered to have complied with these requirements if, after having cooled to the reference temperature, it has errors not exceeding those relating to its class index; however, the overloads shall not be repeated.

6.5 Limiting values of temperature

See Part 1.

6.6 Deviation from zero

For the recommended test, see Sub-clause **4.9** of Part 9.

If a wattmeter or varmeter has a zero position marked on the scale, it shall be tested for deviation from zero.

The test shall be carried out under reference conditions.

6.6.1 ***All circuits energized***

After a period of energization of 30 s at the upper limit of the measuring range, the deviation of the index from the zero scale mark, expressed as a percentage of the scale length, shall not exceed a value corresponding to 50 % of the class index.

6.6.2 ***Voltage circuit(s) only energized***

With the voltage circuit(s) only energized, the deviation of the index from the zero scale mark shall not exceed a value corresponding to 100 % of the class index.

7 Constructional requirements

7.1 and **7.2** See Part 1.

7.3 Preferred values

The upper limit of the measuring range for wattmeters and varmeters shall preferably be one of the following values:

1, 1.2, 1.5, 2, 2.5, 3, 4, 5, 6, 7.5, 8

or their decimal multiples and sub-multiples.

For multi-range instruments, at least one of the ranges shall preferably comply with this requirement.

7.4 Adjuster(s), mechanical and/or electrical

See Part 1.

7.5 Effects of vibration and shock

See Part 1.

8 Information, general markings and symbols

See Part 1.

9 Markings and symbols for terminals

9.1 to **9.3** See Part 1.

9.4 Special markings for terminals

All terminals shall be marked to ensure that they can be uniquely identified.

9.4.1 ***Single element instruments***

Wattmeters and varmeters having only two current terminals and two voltage terminals shall have the current and voltage terminals easily distinguishable. The current terminal which is normally associated with a particular voltage terminal shall be identified by both of them being marked with a common sign.

9.4.2 ***Polyphase instruments***

For all polyphase wattmeters and varmeters, a connection diagram shall be provided, preferably affixed to the case.

The identification of a terminal on the instrument and on the connection diagram shall be identical.

The connection diagram shall show the intended interconnection of the elements of the instrument with the external circuit.

10 Tests to prove compliance with this standard

See Part 1.

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National appendix W

The United Kingdom participation in the preparation of this European Standard was entrusted by the Power Electrical Engineering Standards Policy Committee (PEL/-) to Technical Committee PEL/13 upon which the following bodies were represented:

Committee PEL/13 upon which the following bodies were represented:

Association of Consulting Engineers
Association of Supervisory and Executive Engineers
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Department of Trade and Industry (National Physical Laboratory)
Department of Trade and Industry (National Measurement Accreditation Service)
Electrical Power Engineers' Association
Electricity Supply Industry in England and Wales
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