

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

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

Appareils mesureurs électriques indicateurs analogiques à action directe et  
leurs accessoires –  
**Partie 3: Exigences particulières pour les wattmètres et les varmètres**





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# INTERNATIONAL STANDARD

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[standards.iteh.ai](http://standards.iteh.ai)  
Part 3: Special requirements for wattmeters and varmeters

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[standards.iteh.ai](http://standards.iteh.ai)  
Partie 3: Exigences particulières pour les wattmètres et les varmètres

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### DIRECT ACTING INDICATING ANALOGUE ELECTRICAL MEASURING INSTRUMENTS AND THEIR ACCESSORIES –

#### Part 3: Special requirements for wattmeters and varmeters

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International Standard IEC 60051-3 has been prepared by IEC technical committee 85: Measuring equipment for electrical and electromagnetic quantities.

This fifth edition cancels and replaces the fourth edition published in 1984 and Amendment 1:1994. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) updating of content in line with new editions of IEC 60051-1 and IEC 60051-9;
- b) addition of Annex A to specify the nonconformity classification of test items.

The text of this International Standard is based on the following documents:

CDV	Report on voting
85/556/CDV	85/579A/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

This International Standard is to be used in conjunction with IEC 60051-1:2016.

A list of all parts in the IEC 60051 series, published under the general title *Direct acting indicating analogue electrical measuring instruments and their accessories*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
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## INTRODUCTION

IEC 60051 is published in separate parts according to the following structure and under the general title: *Direct acting indicating analogue electrical measuring instruments and their accessories*.

- 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 synchrosopes
- 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

IEC 60051-3 is not complete in itself and is read in conjunction with IEC 60051-1.

All of these parts are arranged in the same format and a standard relationship between subject and clause number is maintained throughout these parts. This arrangement will assist the reader of IEC 60051 to distinguish information relating to the different types of instruments.

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## DIRECT ACTING INDICATING ANALOGUE ELECTRICAL MEASURING INSTRUMENTS AND THEIR ACCESSORIES –

### Part 3: Special requirements for wattmeters and varmeters

#### 1 Scope

This part of IEC 60051 applies to direct acting indicating wattmeters and varmeters having an analogue display.

NOTE For multi-function instruments, see IEC 60051-7.

It also applies to:

- non-interchangeable accessories (as defined in 3.1.23 of IEC 60051-1:2016) used with wattmeters and varmeters;
- a combination of the instruments and the accessories provided that the adjustments have been made for the combination;
- direct acting indicating electrical measuring instruments whose scale marks do not correspond directly to their electrical input quantity, provided that the relationship between them is known; **THE STANDARD PREVIEW**  
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- instruments and accessories having electronic devices in their measuring and/or auxiliary circuits.

This document does not apply to: [IEC 60051-3:2018](#)

<https://standards.iteh.ai/catalog/standards/sist/47fc0b15-6a1f-4b17-a8de-0530050001-0-218>

- special purpose instruments which are covered by their own IEC standards;
- special purpose devices which are covered by their own IEC standards when they are used as accessories.

#### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60051-1:2016, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 1: Definitions and general requirements common to all parts*

IEC 60051-9, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 9: Recommended test methods*

#### 3 Terms and definitions

See IEC 60051-1:2016.

#### 4 Description, classification and compliance

##### 4.1 Description

See IEC 60051-1:2016.

## 4.2 Classification

See IEC 60051-1:2016.

## 4.3 Compliance with the requirements of this standard

See IEC 60051-1:2016.

## 5 Requirements

### 5.1 Reference conditions

See IEC 60051-1:2016; the reference value of the influence quantities should be as given in Table 2 of IEC 60051-1:2016 and Table 1.

**Table 1 – Reference conditions and tolerances, in addition to those given in Table 2 of IEC 60051-1:2016, for testing purposes relating to the influence quantities**

Influence quantity	Reference conditions unless otherwise marked	Tolerance permitted for testing purposes, applicable for a single reference value <sup>a</sup>
Voltage component of the measured power	Rated voltage or any voltage within the reference range	±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	
Frequency of voltage and current components of the measured power	Instruments using phase shifting devices <a href="https://standards.iec.ch/standard/60051-3-2018">IEC 60051-3:2018</a> Other instruments: 45 Hz to 65 Hz b15-6	±0,1 % of the reference frequency ±2 % of the reference frequency
Power factor	PF = 1 or rated value <a href="https://standards.iec.ch/standard/60051-3-2018">bb04e9f83960_iec-60051-3-2018</a>	0,01 lagging or leading
Phase balance (for polyphase instruments)	Symmetrical voltages and currents	c d

<sup>a</sup> 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.

<sup>b</sup> Power factor for varmeters. Positive sign for lagging (inductive), negative sign for leading (capacitive).

<sup>c</sup> 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°.

<sup>d</sup> Single-phase testing of polyphase instruments is acceptable if permitted by the manufacturer.

### 5.2 Limits of intrinsic uncertainty, fiducial value

#### 5.2.1 Limits of intrinsic uncertainty

See IEC 60051-1:2016.

#### 5.2.2 Correspondence between intrinsic uncertainty and accuracy class

See IEC 60051-1:2016.

### 5.2.3 Fiducial value

**5.2.3.1** The fiducial value for a wattmeter or varmeter corresponds to the following.

**5.2.3.2** 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 for these wattmeters or varmeters is marked using Symbol E-1 given in Table 6 of IEC 60051-1:2016 (see Clause 6 of IEC 60051-1:2016).

**5.2.3.3** The sum of the absolute values of the upper and lower limit of the measuring range when both the mechanical and the electrical zeros are displaced within the scale.

The class index for these wattmeters or varmeters is marked using Symbol E-1 given in Table 6 of IEC 60051-1:2016 (see Clause 6 of IEC 60051-1:2016).

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

The class index for these wattmeters or varmeters is marked using Symbol E-10 given in Table 6 of IEC 60051-1:2016 (see Clause 6 of IEC 60051-1:2016).

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 IEC 60051-2 or 5.2.3.3 as appropriate.

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## 5.3 Nominal range of use and variations

### 5.3.1 Nominal range of use

See IEC 60051-1:2016; the limits of the nominal range of use for influence quantities shall be as given in Table 3 of IEC 60051-1:2016 and Table 2.

**Table 2 – Limits of the nominal range of use and permissible variations  
in addition to those given in Table 3 of IEC 60051-1:2016**

Influence quantity	Distortion factor <b>iTeh STANDARD</b> <b>(standards.iteh.ai)</b>	Limits of the nominal range of use unless otherwise marked	Permissible variation expressed
Distortion of AC voltage or current components of the measured power	Distortion factor devices	Instruments using phase shifting 5 % Other instruments 20 %	100 %
Frequency of AC voltage and current components of the measured power	Peak factor <sup>a</sup> <a href="https://standards.iteh.ai/">https://standards.iteh.ai/</a>	IEC 60159-3 <sup>b</sup> , 2018	200 %
	Instruments using analog reference frequency ± 1 % or lower limit of phase shifting (049833) reference range ± 10 % and upper limit of reference range + 1 %	Reference frequency ± 10 % or lower limit of reference range - 10 % and upper limit of reference range + 10 %	100 %
Voltage components of the measured power		Reference voltage ± 15 % or lower limit of reference range - 15 % and upper limit of reference range + 15 %	100 %
Power factor for wattmeters	Class indices 0,3 and smaller	Any: lagging or leading	100 %
	Class indices 0,5 and greater	Phase angle 0° ... 60° <sup>c</sup> lagging (inductive)	
Power factor for varmeters	Class indices 0,3 and smaller	Any: lagging or leading	100 %
	Class indices 0,5 and greater	Phase angle 0° ... 60° <sup>c</sup> lagging (inductive)	
Phase balance (for polyphase instruments)		Disconnection of one current component of the measured power	200 %
Interaction between measuring elements of polyphase instruments <sup>d</sup>		Disconnection of one voltage component of the measured power	200 %

Influence quantity	Limits of the nominal range of use unless otherwise marked	Permissible variation expressed	
Magnetic field of external origin	0,4kA/m	Class indices 0,3 and smaller	Class indices 0,5 and greater
	Electrodynamic instruments if not static and/or not having a magnetic screen	3 % of the fiducial values <sup>e</sup>	6 % of the fiducial values <sup>e</sup>
	Ferrodynamic instruments if not static and/or not having a magnetic screen	1,5 % of the fiducial values <sup>e</sup>	3 % of the fiducial values <sup>e</sup>
	All other instruments	0,75 % of the fiducial values <sup>e</sup>	1,5 % of the fiducial values <sup>e</sup>

<sup>a</sup> For instruments having electronic devices in their measuring circuits.  
<sup>b</sup> 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:  
1) the instrument peak factor capability producing a variation of 100 % of the class index;  
2) the upper and lower limits of the frequency response (bandwidth) to 0,707 times the indication at the reference frequency;  
3) the effective maximum rate of change of internal instrument AC amplifier response (slew rate), expressed in volts per second using appropriate SI 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.  
<sup>c</sup> Inductive power factor unless otherwise agreed between manufacturer and user.  
<sup>d</sup> 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.  
<sup>e</sup> Not as a percentage of the class index.