



BSI Standards Publication

Direct acting indicating analogue electrical measuring instruments and their accessories

Part 1: Definitions and general requirements
common to all parts (IEC 60051-1:2016)

National foreword

This British Standard is the UK implementation of EN 60051-1:2017. It is identical to IEC 60051-1:2016. It supersedes BS EN 60051-1:1999, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/85, Measuring equipment for electrical and electromagnetic quantities.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Date	Text affected
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English Version

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

Appareils de mesure électriques indicateurs analogiques à
action directe et leurs accessoires - Partie 1: Définitions et
exigences générales communes à toutes les parties
(IEC 60051-1:2016)

Direkt anzeigende analoge elektrische Messgeräte und ihr
Zubehör - Teil 1: Definitionen und allgemeine
Anforderungen für alle Teile
(IEC 60051-1:2016)

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

The text of document 85/521/FDIS, future edition 6 of IEC 60051-1, prepared by IEC/TC 85 "Measuring equipment for electrical and electromagnetic quantities" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60051-1:2017.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2017-10-28
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2020-04-28

This document supersedes EN 60051-1:1998.

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This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

Endorsement notice

The text of the International Standard IEC 60051-1:2016 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated :

IEC 60359:2001	NOTE	Harmonized as EN 60359:2002.
IEC 61557-12:2007	NOTE	Harmonized as EN 61557-12:2008.
IEC 62052-11:2003	NOTE	Harmonized as EN 62052-11:2003.
IEC 62586-1:2013	NOTE	Harmonized as EN 62586-1:2014.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60051-9	-	Direct acting indicating analogue electrical measuring instruments and their accessories -- Part 9: Recommended test methods	EN 60051-9	-
IEC 60359	2001	Electrical and electronic measurement equipment - Expression of performance	EN 60359	2002
IEC 60529	2013	Degrees of protection provided by-enclosures (IP Code)	-	-
+ A1	1995	-	-	-
IEC 60721-3-3	1994	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities -- Section 3: Stationary use at weatherprotected locations	EN 60721-3-3	1995
+ A2	1996	-	+ A2	1997
IEC 60721-3-7	1995	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities -- Section 7: Portable and non-stationary use	EN 60721-3-7	1995
+ A1	1996	-	+ A1	1997
IEC 61010-1	2010	Safety requirements for electrical equipment for measurement, control and laboratory use -- Part 1: General requirements	EN 61010-1	2010
IEC 61010-2-030	2010	Safety requirements for electrical equipment for measurement, control and laboratory use -- Part 2-030: Particular requirements for testing and measuring circuits	EN 61010-2-030	2010
IEC 61326-1	2012	Electrical equipment for measurement, control and laboratory use - EMC requirements -- Part 1: General requirements	EN 61326-1	2013

EN 60051-1:2017

IEC 61326-2-1	-	Electrical equipment for measurement, control and laboratory use - EMC requirements -- Part 2-1: Particular requirements - Test configurations, operational conditions and performance criteria for sensitive test and measurement equipment for EMC unprotected applications	EN 61326-2-1	-
ISO 780	-	Packaging - Pictorial marking for handling of goods	EN ISO 780	-

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**DIRECT ACTING INDICATING ANALOGUE ELECTRICAL
MEASURING INSTRUMENTS AND THEIR ACCESSORIES –****Part 1: Definitions and general requirements common to all parts**

FOREWORD

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International Standard IEC 60051-1 has been prepared by IEC technical committee 85: Measuring equipment for electrical and electromagnetic quantities.

This sixth edition cancels and replaces the fifth edition published in 1997. This edition constitutes a technical revision.

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

- adding the EMC requirements;
- updating the safety symbols and requirements according to new IEC 61010 series;
- replacing the concept of “error” to the concept of “uncertainty”;
- adding service environment classification and classification by method of operation, mechanical condition and the degrees of protection;

- adding the requirements for transport and storage of instruments and accessories according to IEC 60359;
- updating the Annexes to provide more information.

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

FDIS	Report on voting
85/521/FDIS	85/536/RVD

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

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

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 publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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 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 this Part 1.

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

DIRECT ACTING INDICATING ANALOGUE ELECTRICAL MEASURING INSTRUMENTS AND THEIR ACCESSORIES –

Part 1: Definitions and general requirements common to all parts

1 Scope

This part of IEC 60051 specifies definitions and general requirements for direct acting indicating analogue electrical measuring instruments and their accessories.

This part applies to direct acting indicating analogue electrical measuring instruments, such as:

- ammeters and voltmeters;
- wattmeters and varmeters;
- frequency meters of pointer and vibrating-reed types;
- phasemeters, power-factor meters and synchrosopes;
- ohmmeters(impedance meters) and conductance meters;
- multi-function instruments of the above types.

It also applies to:

- certain accessories used with these instruments, such as:
 - shunts;
 - series resistors and impedance elements;
- combination of the instruments and the accessories provided that the adjustments have been made for the combination;
- direct acting indicating electrical measuring instrument whose scale marks do not correspond directly to its electrical input quantity, provided that the relationship between them is known;
- instruments and accessories having electronic devices in their measuring and/or auxiliary circuits.

These series standards do not apply to:

- 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.

This standard does not specify requirements concerning dimensions of instruments or accessories (for the former, see IEC 60473).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60051-9, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 9: Recommended Test Methods*¹

IEC 60359:2001, *Electrical and electronic measurement equipment – Expression of performance*

IEC 60529:2013, *Degrees of protection provided by enclosures (IP Code)*

IEC 60721-3-3:1994, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weatherprotected locations*

IEC 60721-3-3/AMD1:1995

IEC 60721-3-3/AMD2:1996

IEC 60721-3-7:1995, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 7: Portable and non-stationary use*

IEC 60721-3-7/AMD1:1996

IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61010-2-030:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for testing and measuring circuits*

IEC 61326-1:2012, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

IEC 61326-2-1:2012, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-1: Particular requirements – Test configurations, operational conditions and performance criteria for sensitive test and measurement equipment for EMC unprotected applications*

ISO 780:1997, *Packaging – Pictorial marking for handling of goods*

3 Terms and definitions

For the purpose of this standard, the terms and definitions given in IEC 60359 as well as the following, apply.

3.1 General terms

3.1.1

electrical measuring instrument

measuring instrument intended to measure an electrical or non-electrical quantity using electrical or electronic means

[SOURCE: IEC 60359:2001, 3.2.4]

3.1.2

analogue display instrument

measuring instrument intended to present or display the output information as a continuous function of the measured quantity

¹ To be published.

Note 1 to entry: An instrument in which a change of the indication occurs by small discrete steps, but which does not have a digital display, is considered to be an analogue display instrument.

3.1.3

indicating instrument

measuring instrument which displays at any time the value of the measured quantity without recording it

Note 1 to entry: The indicated value may be different from the value of the quantity measured by the instrument and may be in units of a different quantity.

3.1.4

direct acting indicating instrument

instrument in which the indicating device is mechanically connected to and actuated by the moving element

3.1.5

multi-function instrument

instrument having a single means of indication intended for the measurement of more than one kind of quantity (e.g. an instrument measuring current, voltage and resistance)

3.1.6

fixed instrument

measuring instrument designed to be permanently mounted and which is intended to be connected by means of permanently installed conductors

[SOURCE: IEC 60050-300:2001, 312-02-17]

3.1.7

portable instrument

instrument specifically designed to be carried by hand

Note 1 to entry: The instrument is intended to be connected and disconnected by the user.

3.1.8

hand-held instrument

instrument intended to be held by one hand during normal use

3.1.9

panel mounted instrument

fixed installed instrument intended to be mounted in a cut out of a panel or a chassis

[SOURCE: IEC 62586-1:2013, 3.1.6]

3.1.10

polyphase instrument

instrument for measurement in a polyphase system and arranged for connection to more than one phase of the system

3.1.11

astatic instrument

measuring instrument in which the measuring element is, by design, unaffected by uniform magnetic fields of external origin

[SOURCE: IEC 60050-300:2001, 312-02-05]

3.1.12

ammeter

instrument intended to measure the value of a current

[SOURCE: IEC 60050-300:2001, 313-01-01]

3.1.13

voltmeter

instrument intended to measure the value of a voltage

[SOURCE: IEC 60050-300:2001, 313-01-03]

3.1.14

ohmmeter

resistance meter

instrument intended to measure electrical resistance

[SOURCE: IEC 60050-300:2001, 313-01-09]

3.1.15

wattmeter

instrument intended to measure active power

[SOURCE: IEC 60050-300:2001, 313-01-06]

3.1.16

varmeter

instrument intended to measure reactive power

[SOURCE: IEC 60050-300:2001, 313-01-07]

3.1.17

phase meter

instrument which indicates the phase angle between two electrical input quantities of the same frequency and of similar waveform

Note 1 to entry: Such an instrument measures:

– the phase angle between a voltage and another voltage or between a current and another current,

or

– the phase angle between a voltage and a current.

3.1.18

power factor meter

instrument intended to measure the ratio of the active to the apparent power in an electrical circuit

[SOURCE: IEC 60050-300:2001, 313-01-14]

3.1.19

synchroscope

instrument intended to indicate that two alternating voltages or polyphase voltage systems have the same frequency and are in phase

[SOURCE: IEC 60050-300:2001, 313-01-22]

3.1.20

accessory

element, group of elements or device associated with the measuring circuit of a measuring instrument in order to confer specified characteristics to the measuring instrument

3.1.21

interchangeable accessory

accessory having its own properties and accuracy, these being independent of those of the instrument with which it may be associated

Note 1 to entry: An accessory is considered to be interchangeable when its rated characteristics are known and marked and are sufficient to enable its errors and variations to be determined without using the associated instrument. A shunt whose adjustment takes into account an instrument current which is not negligible and which is known, is considered to be interchangeable.

3.1.22

accessory of limited interchangeability

accessory having its own properties and accuracy, which can only be associated with measuring instruments for which certain characteristics are within specified limits

3.1.23

non-interchangeable accessory

accessory adjusted to take into account the electrical characteristics of a specific measuring instrument

3.1.24

shunt

resistor connected in parallel with a measuring circuit of a measuring instrument

Note 1 to entry: A shunt is generally intended to provide a voltage proportional to a current to be measured.

3.1.25

series resistor (impedance)

resistor (impedance) connected in series with a measuring circuit of a measuring instrument

Note 1 to entry: A series resistor (impedance) is generally intended to extend the voltage measuring range of an instrument.

3.1.26

instrument lead

lead comprising one or more conductors, specially designed for interconnecting measuring instruments to external circuits or to accessories

3.1.27

calibrated instrument lead

instrument lead whose resistance has a specified value

Note 1 to entry: A calibrated instrument lead is considered as being an interchangeable accessory of a measuring instrument.

3.1.28

distortion factor (total harmonic distortion factor) (of a quantity)

ratio of the r.m.s. value of the harmonic content to the r.m.s. value of the non-sinusoidal quantity

3.1.29

ripple content of a quantity

ratio of the r.m.s. value of the fluctuating component to the value of the d.c. component

3.1.30

peak factor

ratio of the peak value to the r.m.s. value of a periodic quantity

3.2 Description of instruments according to their method of operation

3.2.1

permanent-magnet moving-coil instrument

instrument which operates by the interaction of the magnetic field due to a current in a movable coil with the field of a fixed permanent magnet

Note 1 to entry: The instrument can have more than one coil, measuring the sum or ratio of the currents in them.

3.2.2

moving-magnet instrument

instrument which operates by the interaction of the field of a movable permanent magnet with the magnetic field due to a current in a fixed coil

Note 1 to entry: The instrument can have more than one coil.

3.2.3

moving-iron instrument

instrument which operates by the attraction between a movable piece of soft magnetic material and the field due to a current in a fixed coil or by the repulsion (and attraction) between one (or more) fixed piece(s) of soft magnetic material and a movable piece of soft magnetic material, both (all) magnetized by a current in a fixed coil

3.2.4

polarized moving-iron instrument

instrument comprising a movable piece of soft magnetic material polarized by a fixed permanent magnet and magnetically excited by a current in a fixed coil

3.2.5

electrodynamic instrument

instrument which operates by the interaction of the magnetic field due to a current in a movable coil with the magnetic field due to a current in one or more fixed coils

3.2.6

ferrodynamic instrument (iron-cored electrodynamic instrument)

electrodynamic instrument in which the electrodynamic effect is modified by the presence of soft magnetic material in the magnetic circuit

3.2.7

induction instrument

instrument which operates by the interaction of the magnetic field(s) of (a) fixed a.c. electromagnet(s) with the magnetic field(s) due to currents which they induce in (a) movable conductive element(s)

3.2.8

thermal instrument (electrothermal instrument)

instrument which operates by the heating effect(s) of (a) current(s) on it(s) conductor(s)

3.2.8.1

bimetallic instrument

thermal instrument in which the deformation of a bimetallic element (the materials having different rates of expansion due to a change in temperature), heated directly or indirectly by a current, produces the indication

3.2.8.2

thermocouple instrument

thermal instrument making use of the e.m.f. of one or more thermocouples heated by the current to be measured

Note 1 to entry: The e.m.f. is often measured using a permanent-magnet moving-coil instrument

3.2.9

rectifier instrument

instrument which is the combination of a measuring instrument sensitive to direct current and a rectifying device whereby alternating currents or voltages may be measured

3.2.10

electrostatic instrument

instrument the operation of which depends on the effects of electrostatic forces between fixed and movable electrodes

3.2.11

pointer-type frequency meter

instrument which indicates the measured frequency by the relationship between an index and a scale

3.2.12

vibrating-reed frequency meter

instrument intended to measure frequency, comprising a set of tuned vibrating reeds, one or a few of which resonate under the action of an alternating current of the relevant frequency flowing through one or more fixed coils

3.2.13

ratiometer (quotientmeter)

instrument for measuring the ratio (quotient) of two quantities

3.2.14

R.M.S.-responding instrument

instrument which, over a specified frequency range, provides an indication which is designed to be proportional to the root-mean-square value of the measured quantity, even when it is not sinusoidal or containing a d.c. part

3.2.15

mean value-responding instrument

instrument with scale of R.M.S. value but which, over a specified frequency range, provides an indication which is designed to be proportional to the mean value of the measured quantity

Note 1 to entry: These instruments do not reflect R.M.S. value of a measurand when the measurand is not sinusoidal or containing a d.c. part.

3.3 Constructional features of instruments

3.3.1

measuring circuit (of an instrument)

part of the electrical circuit internal to the instrument and its accessories, together with the interconnecting leads, if any, which is energized by a voltage or a current, one or both of these quantities being a prime factor in determining the indication of the measured quantity (one of these quantities may be the measured quantity itself)

3.3.1.1

current circuit

measuring circuit through which flows a current which is a prime factor in determining the indication of the measured quantity

Note 1 to entry: It may be the current directly involved in the measurement or a proportional current supplied by an external current transformer or derived from an external shunt.

3.3.1.2

voltage circuit

measuring circuit to which is applied a voltage which is a prime factor in determining the indication of a measured quantity

Note 1 to entry: It may be the voltage directly involved in the measurement or a proportional voltage supplied by an external voltage transformer or an external voltage divider or derived by means of an external series resistor (impedance).

3.3.2

external measuring circuit

part of the electrical circuit external to the instrument from which a measured value is obtained

3.3.3

auxiliary circuit

circuit, other than a measuring circuit, required for the operation of the instrument

3.3.4

auxiliary supply

auxiliary circuit which provides electrical energy

3.3.5

measuring element

assembly of those parts of a measuring instrument which are acted upon by a measured quantity, resulting in a movement of the moving element related to that quantity

3.3.6

moving element

moving part of a measuring element

3.3.7

indicating device

part of a measuring instrument which displays values of the measured quantity

3.3.8

index

means which, in conjunction with the scale, indicates the position of the moving element of an instrument

3.3.9

scale

series of marks and numbers from which, in conjunction with the index, the value of the measured quantity is obtained

3.3.10

scale marks

marks on the dial for the purpose of dividing it into suitable intervals so that the position of the index may be determined

3.3.11

zero scale mark

mark on the dial associated with the figure zero

3.3.12

scale division

distance between any two consecutive scale marks

3.3.13

scale numbers

series of numbers which are associated with the scale marks

3.3.14

dial

surface which carries the scale and other marks and symbols

3.3.15

mechanical zero

equilibrium position which the index will approach when the measuring element (if mechanically controlled) is de-energized.

Note 1 to entry: This may or may not coincide with the zero scale mark.

Note 2 to entry: In mechanically suppressed zero instruments, the mechanical zero does not correspond to a scale mark.

Note 3 to entry: In instruments without restoring torque the mechanical zero is indeterminate.

3.3.15.1

mechanical zero adjuster

mechanism by means of which the instrument may be adjusted so that the mechanical zero coincides with the appropriate scale mark

3.3.15.2

mechanical span adjuster

mechanism by means of which the instrument may be adjusted so that the lower/upper limit of the measuring range coincides with the appropriate scale mark

3.3.16

electrical zero

equilibrium position which the index will approach when the measured electrical quantity is either zero or a set value and the control circuit (if any), producing a restoring torque, is energized

3.3.16.1

electrical zero adjuster

for an instrument which needs an auxiliary supply, the mechanism by means of which the instrument may be adjusted so that the electrical zero coincides with the appropriate scale mark

3.3.16.2

electrical span adjuster

for an instrument which needs an auxiliary supply, the mechanism by means of which the instrument may be adjusted so that the lower/upper limit of the measuring range coincides with the appropriate scale mark

3.4 Characteristic features of instruments

3.4.1

scale length

length of the line (curved or straight) which passes through the centres of all the shortest scale marks contained between the first and the last scale marks

Note 1 to entry: It is expressed in units of length.

Note 2 to entry: If an instrument has more than one scale, each scale may have its own scale length. For convenience, the scale length of the instrument is taken to be that of the major scale.

3.4.2

span

algebraic difference between the upper and lower limits of the measuring range

Note 1 to entry: It is expressed in units of the measured quantity.