BRITISH STANDARD

BS EN 61143-1:1994
IEC 1143-1: 1992

Incorporating Amendment No. 1 to BS 7610-1:1992 (renumbers the BS as BS EN 61143-1:1994) and amendment No. 1 to BS EN 61143-1: 1994

Electrical measuring instruments — X-t recorders —

Part 1: Definitions and requirements

The European Standard EN 61143-1:1994 with the incorporation of amendment A1:1997 has the status of a British Standard

ICS 17.220.20

Committees responsible for this British Standard

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

Association of Consulting Engineers

Department of Energy (Electricity Division)

Department of Trade and Industry (National Physics Laboratory)

Electricity Association

The Association for the Instrumentation, Control and Automation Industry GAMBICA (BEAMA Ltd.)

Institution of Electrical Engineers

Institution of Incorporated Executive Engineers

This British Standard, having been prepared under the direction of the Power Electrical Engineering Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on
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The following BSI references relate to the work on this standard:
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Amendments issued since publication

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Contents

National foreword

This British Standard has been prepared by Technical Committee PEL/85 (formerly PEL/13) and is the English language version of EN 61143-1:1994 including amendment A1:1997. It is identical with IEC 1143-1:1992 including amendment 1:1997.

It is envisaged that Part 2 which specifies test methods will be published at a later date and an identical British Standard will follow.

Cross-references

International standard	Corresponding British Standard
	BS 89 *Direct acting indicating analogue electrical measuring instruments and their accessories*
IEC 51-1:1984	Part 1:1990 *Specification for definitions and general requirements common to all Parts* (Identical)
IEC 51-2:1984	Part 2:1990 *Specification for special requirements for ammeters and voltmeters* (Identical)
IEC 51-3:1984	Part 3:1990 *Specification for special requirements for wattmeters and varmeters* (Identical)
IEC 51-4:1984	Part 4:1990 *Specification for special requirements for frequency meters* (Identical)
IEC 51-5:1985	Part 5:1990 *Specification for special requirements for phase meters, power factor meters and synchroscopes* (Identical)
IEC 51-6:1984	Part 6:1990 *Specification for special requirements for ohmmeters (impedance meters) and conductance meters* (Identical)
IEC 51-7:1984	Part 7:1990 *Specification for special requirements for multi-function instruments* (Identical)
IEC 51-8:1984	Part 8:1990 *Specification for special requirements for accessories* (Identical)
IEC 51-9:1988	BS 89-9:1990 *Recommended test methods* (Identical)
	BS 2011 *Environmental testing*
IEC 68-2-6:1982	Part 2.1Fc: 1983 *Test Fc. Vibration (sinusoidal)* (Identical)
IEC 68-2-27:1987	Part 2.1Ea: 1988 *Test Ea. Shock* (Identical)
IEC 414:1973	BS 5458:1977 *Specification for safety requirements for indicating and recording electrical measuring instruments and their accessories* (Identical)
IEC 617-2:1983	BS 3939 *Graphical symbols for electrical power, telecommunications and electronics diagrams* Part 2:1985 *Symbol elements, qualifying symbols and other symbols having general application* (Identical)

The Technical Committee has reviewed the provisions of IEC 27, IEC 417, IEC 473 and IEC 1010 to which normative reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard.

A related British Standard to IEC 417:1973 is BS 5817-8:1990 *Specification for audiovisual, video and television equipment and systems — Part 8: Symbols and identification.*

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, the EN title page, pages 2 to 26, 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.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61143-1

June 1994

+ A1

November 1997

ICS 19.080

Supersedes HD 301 SI:1977

Descriptors: Measuring instrument, electrical measurement, recorder, X-t recorder

English version

Electrical measuring instruments — X-t recorders Part 1: Definitions and requirements

(Includes amendment A1:1997)
(IEC 1143:1992 + A1:1997)

Appareils électriques de mesure — Enregistreurs X-t
Partie 1: Définitions et prescriptions
(inclut l'amendement A1:1997)
(CEI 1143:1992 + A1:1997)

Elektrische Meßgeräte — X-t-Schreiber
Teil 1: Begriffe und Anforderungen
(Enthält Änderung A1:1997)
(IEC 1143:1992 + A1:1997)

This European Standard was approved by CENELEC on 1994-03-08; amendment A1 was approved by CENELEC on 1997-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 1143-1:1992 could be accepted without textual changes, has shown that no common modifications were necessary for the acceptance as European Standard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as EN 61143-1 on 8 March 1994.

This European Standard replaces HD 301 S1:1977.

The following dates were fixed:

— latest date of publication of an identical national standard (dop) 1995-03-15

— latest date of withdrawal of conflicting national standards (dow) 1995-03-15

For products which have complied with HD 301 S1:1977 before 1995-03-15, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2000-03-15.

Annexes designated “normative” are part of the body of the standard. In this standard, Annex ZA is normative.

Foreword to amendment A1

The text of the document 85/162/FDIS, future amendment 1 to IEC 61143-1:1992, 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 61143-1:1994 on 1997-10-01.

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 endorsement (dop) 1998-07-01

— latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1998-07-01

For products which have complied with EN 61143-1:1994 before 1998-07-01 as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2003-07-01.

1 Scope

This part of IEC 1143 applies to X-t recorders used for the measurement of voltage and current which measure and record analogue electrical quantities as a function of time.

It also applies to a recorder whose chart scale lines do not correspond directly to the electrical input quantity, provided that the relationship between them is known.

For the measurement of other electrical quantities, the relevant parts of IEC 51 also apply.

This part also applies to non-interchangeable accessories and accessories of limited interchangeability (e.g. shunts, impedance elements) if they are used with the recorder and the adjustments have been made for the combination. For controllers with electrical outputs and containing electrical recorders, this part applies only to the recorder and does not apply to the control circuit.

This part does not apply to special purpose recorders or to special purpose devices (when they are used as accessories) which are covered by their own IEC standards.

This part does not cover safety requirements (for reference, see IEC 1010) and does not contain either requirements for protection against environmental conditions or the relevant tests. However, when necessary, tests under conditions approaching those of use may be selected from IEC 68, to prove protection against environmental conditions.

Further, it does not contain requirements concerning the dimensions of instruments or accessories (for the former, see IEC 473).

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 1143. At the time of publication of this standard, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 1143 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 27, *Letter symbols to be used in electrical technology.*

IEC 51-1:1984, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 1: Definitions and general requirements common to all parts.*

IEC 51-2:1984, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 2: Special requirements for ammeters and voltmeters.*

IEC 51-3:1984, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 3: Special requirements for wattmeters and varmeters.*

IEC 51-4:1984, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 4: Special requirements for frequency meters.*

IEC 51-5:1985, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 5: Special requirements for phase meters, power factor meters and synchroscopes.*

IEC 51-6:1984, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 6: Special requirements for ohmmeters (impedance meters) and conductance meters.*

IEC 51-7:1984, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 7: Special requirements for multi-function instruments.*

IEC 51-8:1984, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 8: Special requirements for accessories.*

IEC 51-9:1988, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 9: Recommended test methods.*

IEC 68-2-6:1982, *Environmental testing — Part 2: Tests — Test Fc and guidance: Vibration (sinusoidal).*

IEC 68-2-27:1987, *Environmental testing — Part 2: Tests — Test Ea and guidance: Shock.*

IEC 160:1963, *Standard atmospheric conditions for test purposes.*

IEC 417:1973, *Graphical symbols for use on equipment — Index, survey and compilation of the single sheets.*

IEC 473:1974, *Dimensions for panel-mounted indicating and recording electrical measuring instruments.*

IEC 617-2:1983, *Graphical symbols for diagrams — Part 2: Symbol elements, qualifying symbols and other symbols having general application.*

IEC 1010, *Safety requirements for electrical equipment for measurement, control and laboratory use.*

3 Definitions

The values of a.c. quantities given in this part are r.m.s. values, unless otherwise stated.

For the purpose of this part, the following definitions apply.

3.1 General terms

3.1.1
electrical measuring instrument

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

3.1.2
analogue display instrument

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

3.1.3
electronic measuring instrument

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

3.1.4
instrument with electric screen

an instrument shielded by conductive material from the influence of an electric field of external origin

3.1.5 accessory

An element, group of elements or device associated with the measuring circuit of a recorder in order to confer specified characteristics on the recorder.

3.1.5.1
interchangeable accessory

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

NOTE 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 recorder. For example, a shunt whose adjustment takes into account the input current of the recorder and which is not negligible and which is known is considered to be interchangeable.

3.1.5.2
accessory of limited interchangeability

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

3.1.5.3
non-interchangeable accessory

an accessory adjusted to take into account the electrical characteristics of a specific recorder

3.1.6
shunt

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

NOTE A shunt is generally intended to provide a voltage proportional to the current to be measured.

3.1.7
series resistor (impedance)

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

NOTE A series resistor (impedance) is generally intended to extend the voltage measuring range of a recorder.

3.1.8
distortion factor (total harmonic distortion factor of a quantity)

The ratio: $\frac{\text{r.m.s. value of the harmonic content}}{\text{r.m.s. value of the non-sinusoidal quantity}}$

3.1.9
ripple content of quantity

The ratio: $\frac{\text{r.m.s. value of the fluctuating component}}{\text{r.m.s. value of the d.c. component}}$

3.1.10
recorder

a measuring instrument which records on a recording medium information corresponding to the values of the measurand

NOTE 1 Some recorders may incorporate indicating devices.
NOTE 2 Some recorders may record information corresponding to more than one measurand.
NOTE 3 Some recorders may also include interchangeable plug-in units. In this case, a recorder may have different specifications depending on the plug-in unit being used.

3.1.11
indirect acting recorder

a recorder in which the recording device is driven by a motor or other device controlled by the measurand and using electromechanical, electrical or electronic means

3.1.12
drum chart recorder

a recorder in which the chart is wrapped as a single turn around a cylindrical drum which is rotated by the chart driving mechanism

3.1.13
disc recorder

a recorder in which the chart is a disc which is rotated by the chart driving mechanism

3.1.14
strip chart recorder

a recorder in which the chart is a strip driven by the chart driving mechanism

3.1.15
pen recorder

a recorder in which the record on the chart is made by a pen supplied with ink

3.1.16
stylus recorder

a recorder in which the record on the chart is made by a stylus requiring no ink

3.1.17
array recorder

a recorder in which the record is produced by energizing one or more of a series of fixed elements

NOTE For example, these may be heated elements producing dots on thermal sensitive paper.

3.1.18
dotted line recorder

a recorder in which the record comprises a series of successive impressions which may be points, numerals, etc.

NOTE Recorders producing a series of dots which are so close to each other that they appear like a line and the dotting time is short enough to be negligible, compared with the response time of the recorder, are treated as continuous line recorders.

3.1.19
continuous line recorder

a recorder in which the record is a continuous line

3.1.20
single recorder

a recorder having a single recording device

3.1.21
multiple recorder

a recorder having more than one recording device

3.1.22
single range recorder

a recorder having only one measuring range

3.1.23
multi-range recorder

a recorder having more than one measuring range

3.1.24
single channel recorder

a recorder the internal measuring circuit of which is intended to be connected to one external measuring circuit

3.1.25
multiple channel recorder

a recorder which successively connects its internal measuring circuit to different external measuring circuits

3.2 Description of recorders according to their methods of operation

3.2.1
thermocouple recorder

a recorder which is the combination of a recorder sensitive to direct voltage and a thermal converter whereby alternating currents or voltages may be recorded

3.2.2
rectifier recorder

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

3.2.3
r.m.s.-responding recorder

a recorder which, over a specified frequency range, provides a record which is designed to be proportional to the root-mean-square value of the measurand

3.3 Construction features of recorders

3.3.1 measuring circuit

The part of the electrical circuit internal to the recorder 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 record of the measurand (one of these quantities may be the measurand itself).

3.3.1.1
current circuit

a measuring circuit through which flows a current which is the prime factor in determining the record of the measurand

NOTE This current may be the current which is 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

a measuring circuit to which is applied a voltage which is the prime factor in determining the record of a measurand

NOTE This voltage may be the voltage which is 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

the part of the electrical circuit external to the recorder from which the measurand is obtained

3.3.3 auxiliary circuit

A circuit, other than a measuring circuit, required for the operation of the recorder.

3.3.3.1
auxiliary supply

an auxiliary circuit which provides electrical energy

3.3.4
measuring element

the assembly of those parts of a recorder which are acted upon by a measurand, resulting in a corresponding movement of the moving element

3.3.5
moving element

the moving part of a measuring element. [IEV 302-06-02]

3.3.6
indicating device

the part of a recorder which displays the values of the measurand

3.3.7
recording device

the assembly of parts of a recorder which records the value of the measurand

3.3.8
index

the fixed or movable part of a recorder whose position, with reference to the scale marks, enables a recorded value to be determined

3.3.9 scale

tHe series of marks and numerals from which, in conjunction with the index, the value of the measurand is obtained.

3.3.9.1
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

3.3.9.2
zero scale mark

the mark on the dial associated with the figure zero

3.3.9.3
scale division

the distance between any two consecutive scale marks

3.3.10
scale numbering

the series of numerals associated with the scale marks

3.3.11
dial

the surface which carries the scale and other marks and symbols

3.3.12 electrical zero

The equilibrium position which the index will approach when the measurand is either zero or a set value and the control circuit (if any) is energized.

3.3.12.1
electrical zero adjuster

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

3.3.12.2
electrical span adjuster

for a recorder which needs an auxiliary supply, the mechanism by means of which the recorder may be adjusted so that the lower and/or upper limits of the measuring range coincide with the appropriate scale mark

3.3.13
chart

a strip or disc with or without preprinted lines and/or figures from which are obtained the values of the measurand as a function of time, possibly by means of a reading rule

3.3.14 chart lines

The series of lines on the chart which enables the record to be interpreted.

3.3.14.1
chart scale lines

chart lines by means of which the value of each measurand is determined

3.3.14.2
chart time lines

chart lines for determining the time at which the value of each measurand occurred

3.3.15
chart driving mechanism

a mechanism for driving the chart as a function of time

3.3.16
recording width

the length of the record (curved or straight) between the extreme chad scale lines when the chart driving mechanism is stationary

3.4 Characteristic features of recorders

3.4.1
scale length

the 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

it is expressed in units of length

NOTE If a recorder has more than one scale, each scale may have its own scale length. For convenience, the scale length of the recorder is taken to be that of the major scale.

3.4.2
span

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

it is expressed in units of the measurand

example measuring range: – 10 V ... + 10 V: span 20 V

3.4.3
measuring range (effective range)

the range defined by two values of the measurand within which the limits of error of a recorder are specified

NOTE A recorder can have several measuring ranges.

3.4.4
overshoot

the difference between the extreme recorded value and the steady recorded value (expressed in terms of the recorded value corresponding to the span) when the measurand is suddenly changed from one steady value to another

3.4.5
response time

the time interval between the instant when a measurand is subjected to a specified sudden change and the instant when the record reaches and remains within specified limits of its final steady value

3.4.6
frequency response range

the range of frequencies of a sinusoidal measurand to which the recorder will respond within specified limits relating to amplitude

3.4.7
dead band

the range through which the measurand may be varied without producing a change in the record

3.4.8
common mode voltage (between measuring circuit and earth)

the part of the input voltages, for which the amplitude and either the phase or the polarity are the same, which exists between each of the input terminals and a reference point

NOTE This reference point may be the frame, the measuring earth terminal or an inaccessible point.

3.4.9
series mode voltage/parallel mode current

an unwanted part of the input quantity which is superimposed on the input quantity initiated by the measurand

NOTE 1 Typical examples of a series mode voltage are induced voltages, an a.c. ripple on a d.c. signal, or thermopotentials.
NOTE 2 The parasitic input value for a voltage input is a voltage applied in series with the measurand. The parasitic input value for a current input is a current applied in parallel with the measurand.

3.5 Characteristic values

3.5.1
nominal value

a value of a quantity indicating the intended use of a recorder. The characteristics of recorders given by the manufacturer are also nominal values

3.5.2
rated value

a value of a quantity assigned, generally by a manufacturer, for a set of specified operating conditions

3.5.3
fiducial value

a clearly specified value of a quantity to which the errors of a recorder are referred to in order to specify its accuracy

NOTE This value can, for example, be the upper limit of the measuring range, the span or another clearly stated value.

3.5.4
rated chart speed

the values of the chart speed assigned by the manufacturer

3.5.5
dotting time

the interval between the production of two consecutive dots

3.5.6
zero displacement value

for a recorder with zero displacement, the value of the measurand, expressed as a percentage of the span, which corresponds to the difference between the indicated or recorded values with and without the zero displacement for the same value of the measurand

3.5.7
recorder with zero displacement

a recorder which employs an additional device to change the position of the zero

3.6 Influence quantities, reference conditions, nominal range of use and preconditioning

3.6.1
influence quantity

a quantity which is not the subject of the measurement but which influences the value of the record

for example: humidity, ambient temperature, frequency of a measured voltage

3.6.2 reference conditions

Conditions of use for a recorder prescribed for performance testing, or to ensure valid inter comparison of results of measurements.

NOTE Reference conditions generally specify reference values or reference ranges for the influence quantities affecting the recorder.

3.6.2.1
reference value

a specified value of one of a set of reference conditions

3.6.2.2
reference range

a specified range of values of one of a set of reference conditions

3.6.3
nominal range of use

a specified range of values which an influence quantity may assume without causing a variation exceeding specified limits

3.6.4
limiting values of an influence quantity

extreme values which an influence quantity can assume without the recorder or accessory being damaged or permanently altered in such a way that it no longer meets the requirements of its accuracy class

NOTE The limiting values may depend on the duration of their application.

3.6.5
preconditioning

the action whereby, under reference conditions, a specified value of the measurand is applied to the measuring circuit prior to carrying out tests or use of the recorder or accessory

3.6.6
preliminary adjustments

adjustments, specified by the manufacturer, that shall be made before using the recorder so that it will operate with specified accuracy

3.7 Errors and variations

3.7.1
(absolute) error

for a recorder, the value obtained by subtracting the (conventional) true value from the recorded value

for an accessory, the value obtained by subtracting the (conventional) true value from the rated value

NOTE 1 Since the true value cannot be obtained by measurement, a value obtained under specified test conditions and at a specified time is used instead. This value is derived from national measurement standards or reference measurement standards agreed upon by manufacturer and user.

NOTE 2 "Absolute error", which has a sign, should not be confused with "absolute value of an error" which is the modulus of an error.

NOTE 3 When a recorder is used together with an accessory, the error of such a combination is calculated by taking the algebraic sum of the errors of the recorder and the accessory.
NOTE 4 In practice, the error of measurement can only be determined with some uncertainty.

3.7.2
intrinsic error

the error of a recorder when under reference conditions

3.7.3
variation

the difference between the two records for the same value of the measurand for a recorder (or the two true values for an accessory) when a single influence quantity assumes successively two different specified values within the nominal range of use

3.7.4
fiducial error

the ratio of the absolute error to the fiducial value. [IEV 301-08-08]

3.7.5
error in timekeeping

the value obtained by subtracting the true value of elapsed time from the recorded value of time

3.8 Accuracy, accuracy class, class index

3.8.1
accuracy

the ability of a recorder to provide a record approaching the conventional true value of a measurand and of the elapsed time

for an accessory, it is the closeness of the rated value to the conventional true value

NOTE The accuracy of a recorder is defined by the limits of intrinsic errors and by the limits of variations.

3.8.2
accuracy class

a group of recorders and/or accessories which meets certain metrological requirements intended to keep errors and variations within specified limits

3.8.3 Class index

3.8.3.1
measuring class index

the number which designates the measuring accuracy class

NOTE Recorders having more than one measuring range may have more than one measuring class index.

3.8.3.2
timekeeping class index

the number which designates the timekeeping accuracy class

NOTE It is expressed as a percentage of the ratio of the error in timekeeping to the true value of elapsed time.

4 Description, classification and compliance

4.1 Description

Recorders and/or their non-interchangeable accessories shall be described according to their principle of operation and/or by their special characteristics as given in clause **3**.

4.2 Classification

Recorders and their non-interchangeable accessories, satisfying this part are classified according to their accuracy classes related to the measurand and to timekeeping (see **6.4**).

Accuracy class indices shall be selected from a 1 – 1,5 – 2 – 2,5 – 3 – 5 sequence or their decimal submultiples.

4.3 Compliance with the requirements of this part

Recorders and their accessories shall comply with the relevant requirements of this part relating to their accuracy classes. The recommended test methods for checking compliance with the requirements of this part are given in IEC 51-9 and IEC 1143-2.[1)]

4.3.1 If, for the determination of intrinsic errors and variations, preconditioning is necessary, the manufacturer shall specify the preconditioning period and all other relevant conditions. The preconditioning period shall not exceed 30 min.

NOTE The user should be aware that, when preconditioning is specified, the recorder may not comply with the requirements corresponding to its accuracy class until the preconditioning has been completed.

4.3.2 Recorders shall be adequately packed to ensure that, after transport under normal conditions, they comply with the requirements of this part.

5 Reference conditions and intrinsic errors

5.1 Reference conditions

The recorder shall be put into operation according to the manufacturer's specifications.

5.1.1 The reference conditions of the influence quantities shall be as given in Table 1, unless otherwise stated.

The reference value for the ambient temperature shall be specified by the manufacturer and shall be selected from 20 °C, 23 °C or 27 °C in accordance with IEC 160.

5.1.3 Reference conditions different from those given in Table 1 may be specified.

5.2 Fiducial value and limits of intrinsic errors

When the recorder, together with its non-interchangeable accessory(ies) (if any), is under reference conditions and is used within the limits of its measuring range and in accordance with the manufacturer's instructions, the intrinsic error, expressed as a percentage of the fiducial value, shall not exceed the limits appropriate to its accuracy class.

Values stated in a table of corrections supplied with the recorder shall not be taken into account in determining the errors.

NOTE 1 The intrinsic error includes other error components such as those due to dead band, amplifier drift, etc.

NOTE 2 However, for multi-range recorders, the manufacturer may state either the maximum absolute error expressed, for example in millivolts as well as, or instead of, the error implied by the class index.

Examples: Class 1 ± 1 mV (the error can be 1 % ± 1 mV)

Class 1 or 1 mV whichever is the greater (the error can be 1 % or 1 mV).

5.2.1 *Correspondence between intrinsic error and accuracy class*

The maximum permissible error is related to the accuracy class such that the class index is used as the limit of error, expressed as a percentage of the fiducial value, with positive and negative signs.

NOTE For example, for a class index of 0,05 the limits of intrinsic error are ± 0,05 % of the fiducial value.

5.2.2 *Fiducial value*

The fiducial value for the measurand corresponds to the span. The fiducial value for time-keeping corresponds to the true value of the elapsed time. For zero displacement, the fiducial value corresponds to the nominal value of zero displacement.

5.3 Span

For a recorder, the span corresponds to the chart recording width, the value of which shall be stated by the manufacturer.

5.4 Dead band

Under reference conditions the dead band is included within the intrinsic error. The dead band shall not exceed the value corresponding to the class index when any one of the influence quantities is within its nominal range of use.

The manufacturer may only specify a lower limit.

[1)] Recommended additional test methods (under consideration).

5.5 Additional error due to zero displacement

The limits of the additional error due to zero displacement expressed as a percentage of the zero displacement value, shall have a value not exceeding 100 % of the class index.

The manufacturer may only specify a lower value.

6 Nominal range of use and variations

6.1 Nominal range of use

6.1.1 The limits of the nominal range of use for each influence quantity shall be as given in Table 2.

6.1.2 When the manufacturer specifies a nominal range of use which is different from that shown in Table 2, such range shall include the reference range (or reference value with permitted tolerances) and will normally exceed it in at least one direction.

6.1.2.1 For values in the nominal range of use beyond the reference range (or reference value), the variation shall not exceed the values given in Table 2.

Example: For a recorder having a class index of 0,2, the variation due to a change of position of 10° in any direction shall not exceed:

$$0{,}2\ (\%) \times \frac{100}{100} = 0{,}2\ \%\ \text{of the fiducial value}$$

6.1.2.2 When an influence quantity is not one of those shown in Table 2, the relevant value of the influence quantity and the resultant variation shall be stated by the manufacturer. The variation shall not exceed 100 % of the class index.

6.1.2.3 The variation due to mutual influence between the different measuring circuits of multiple recorders and multiple channel recorders shall not exceed 50 % of the value corresponding to the class index.

6.2 Limits of variations

When a recorder is under reference conditions and a single influence quantity is varied, the variation shall not exceed the values given in Table 2 and in **6.1.2.3** and **6.4**. The variation includes thickening of the trace.

6.2.1 *Variation due to a magnetic field of external origin*

6.2.1.1 When the recorder is not marked with symbol F-30 (see Table 4) and no relevant information is given in the documentation, the magnetic field strength shall be 0,4 kA/m at mains frequency.

6.2.1.2 For recorders marked with symbol F-30 (see Table 4) or when relevant information is given in the documentation, the magnetic field strength at mains frequency shall have a value expressed in kiloamperes per metre (kA/m) as given in the symbol or documentation.

6.3 Conditions for the determination of variations

6.3.1 The variations shall be determined for each influence quantity separately.

During each test, all influence quantities shall be maintained at their reference conditions except for the influence quantity for which the variation is to be determined.

6.3.1.1 When an influence quantity has a reference value, it shall be varied between that value and any value within the limits of the nominal range of use as given in Table 2, unless otherwise marked.

6.3.1.2 When an influence quantity has a reference range, it shall be varied from each limit of the reference range to the adjacent limit of the nominal range of use.

6.3.1.3 The determination of variations associated with the influence quantities shall be made with a value of the mesurand between 40 % and 60 % of the span.

6.4 Variation in timekeeping

The variation shall not exceed a value corresponding to 100 % of the timekeeping class index.

NOTE If a recorder has a chart driving mechanism the speed of which depends on the stability of the mains frequency and this has to be constant to make a correct reading in the time axis possible, then this fact should be clearly stated by the manufacturer together with the relationship between mains frequency and chart speed.

6.5 Variation due to parasitic input quantities

The manufacturer shall state those values of the parasitic input quantities for which the variation does not exceed a value corresponding to 100 % of the class index.

The parasitic input quantities may be limited by safety requirements.

The influence of parasitic input quantities shall be stated for:

— common mode interference;

— series/parallel mode interference.

Table 1 — Reference conditions and tolerances for testing purposes relating to the influence quantities

Influence quantity		**Reference conditions** (unless otherwise stated)	**Tolerances permitted for testing purposes, applicable for a single reference value** (note 1)
Ambient temperature		Refer to **5.1.2**	± 2 °C
Relative humidity		40 % to 60 %	—
Position		To be stated by the manufacturer	± 5°
Ripple content of d.c. measurand		Zero	1 %
Distortion of a.c. measurand		Zero	To be stated by the manufacturer
Frequency of a.c. measurand		To be stated by the manufacturer	± 1 %
Magnetic field of external origin		Total absence	40 A/m (note 2) at frequencies from zero to 65 Hz in any direction
Electric field of external origin		Total absence	1 kV/m at frequencies from zero to 65 Hz in any direction
Auxiliary supply (Power supply)	Voltage	Nominal value or nominal range: to be stated by the manufacturer	± 1 % of nominal value
	Frequency	Nominal value or nominal range: to be stated by the manufacturer	± 1 % of nominal value (note 3)
Parasitic input quantities	Series mode voltage, parallel mode current a.c. or d.c.	Zero	1 % of the values indicated in Table 2 for the nominal range of use
	Common mode voltage, a.c. and d.c.	Zero	
Impedance of the external measuring circuit		To be stated by the manufacturer	
Chart		To be stated by the manufacturer	
Recording device (recording means)		To be stated by the manufacturer	

NOTE 1 These tolerances apply when a single reference value is specified in this table or is marked by the manufacturer. For a reference range, no tolerance is allowed.

NOTE 2 40 A/m is approximately the highest value of the earth's magnetic field.

NOTE 3 See **6.4**.

Table 2 — Limits of the nominal range of use and permissible variations

Influence quantity		Limits of the nominal range of use unless otherwise stated	Permissible variation expressed as a percentage of the class index
Ambient temperature		Reference temperature ± 10 °C	100
Relative humidity		25 % to 75%	100
Position		± 10° from the reference position or reference range, if any	100
Ripple on d.c. measurand		To be stated by the manufacturer	
Distortion of a.c. measurand		To be stated by the manufacturer	
Frequency of a.c. measurand		To be stated by the manufacturer	
Magnetic field of external origin		See **6.2.1**	100
Auxiliary supply	Voltage	Reference value ± 10 % or lower limit of reference range – 10 % and upper limit of reference range + 10 %	50
(Power supply)	Frequency	Reference value ± 5 % or lower limit of reference range – 5 % and upper limit of reference range + 5 %	50 (note)
Parasitic input quantities	Series mode voltage, parallel mode current a.c. or d.c.	To be stated by the manufacturer	100
	Common mode voltage, a.c. and d.c.		
Impedance of the external measuring circuit		To be stated by the manufacturer	100

NOTE See **6.4**.

7 Further electrical and mechanical requirements

7.1 Dynamic performance

When the recorder is under reference conditions and is used in accordance with the manufacturer's instructions, it shall meet the following requirements:

7.1.1 *Overshoot*

The values of the overshoot for sudden changes of the measurand corresponding to 95 % as well as to 10 % of the span shall not exceed twice the value corresponding to the class index, or a lower value stated by the manufacturer.

7.1.2 *Response time*

The values of response time for sudden changes of the measurand corresponding to 95 % as well as to 10 % of the span shall not exceed the values stated by the manufacturer. The final steady value is considered to have been reached when the record reaches and remains within one class index of its final steady value. In addition, response times for other values of deflection may be stated by the manufacturer.

The values of acceleration and pen slewing speed, measured at the recording device, shall be equal to or greater than the values stated by the manufacturer.

It is not mandatory that the values be stated but, if stated, the manufacturer shall define an adequate measuring method.

7.1.3 *Frequency response*

If two sinusoidal input quantities corresponding to a peak-to-peak deflection of 2/3 and 1/10 of the span are successively applied, whose frequency is varied between the limits of the specified frequency response range, the deflection at these frequencies shall not deviate by more than 10 % of the d.c. (low frequency-) deflection.

7.2 Continuous use

Recorders shall comply with the requirements corresponding to their accuracy class after being continuously operated under reference conditions.

NOTE For convenience, a test period of 6 h is considered to be sufficient.

7.3 Permissible overloads

The following conditions for applying overloads are only valid for the measuring systems (not for the auxiliary supply).

7.3.1 *Continuous overload*

The recorder shall withstand, without damage, an input quantity corresponding to 120 % of the value of the upper limit of each measuring range for a period of 2 h.

After having cooled to the reference temperature, the recorder shall comply with its accuracy requirements.

7.3.2 *Overload of short duration*

The recorder shall withstand, without damage, an input quantity corresponding to 200 % of the value of the upper limit of each measuring range for a period of 10 s. The manufacturer may only specify higher values for the input quantity and/or time. The only permissible exceptions are those due to safety requirements.

7.4 Limiting values of temperature

7.4.1 Unless otherwise specified, recorders shall operate without incurring permanent damage when subjected to ambient temperatures between 0 °C and 40 °C.

Absence of permanent damage is inferred if, on return to reference conditions, the recorders comply with the requirements relating to intrinsic error.

Adjustment of the recorder zero is permissible.

8 Constructional requirements

8.1 Sealing to prevent access

When the recorder is sealed to prevent unauthorized adjustment, access to the internal circuits and to the components within the case shall not be possible without destroying the seal.

8.2 Scales and charts

8.2.1 *Chart scale lines and chart time lines*

Chart scale lines (chart time lines) relating to the measurand (time) shall correspond to one, two or five times the unit in which the measurand (time) is expressed, or that value multiplied or divided by 10 or 100.

For multi-range recorders or recorders having more than one chart speed, the above requirements shall be fulfilled for at least one measuring range and speed.

8.2.2 *Chart scale numbering*

The numerals of the scale (whole number or decimal) marked on the chart shall not have more than three digits. SI units and their prefixes should be used in association with the chart scale numbering.

8.2.3 *Direction of the trace*

The preferred directions of the trace for increasing values of the measurand shall be from left to right or from front to rear or from bottom to top.

8.2.4 *Limits of the measuring range*

It is not necessary to mark the limits of the measuring range when the value or the nature of the chart scale lines enable the measuring range to be identified without ambiguity.

8.3 Preferred values

8.3.1 ***Upper limit of the measuring range***

The upper limit of the measuring range shall 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.

8.3.2 ***Values of rated chart speed***

8.3.2.1 The rated chart speeds of strip chart recorders shall be one of the following values:

10 – 15 – 20 – 25 – 30 – 40 – 50 – 60 –120 – 180 – 240 mm/h, or mm/min or mm/s

8.3.2.2 The rated chart speeds of disc chart and drum chart recorders shall be one of the following values:

— 1 revolution in 1 – 2 – 6 – 8 – 12 – 24 h;

— 1 revolution in seven days.

8.4 Vibration and shock

Unless otherwise specified, recorders of class indices 1 and greater shall be capable of withstanding the vibration and shocks of the following type tests.

8.4.1 ***Vibration test***

The test method given in IEC 68-2-6 shall be used with the details specified below:

— sweep frequency range: 10 Hz – 55 Hz – 10 Hz;

— displacement amplitude: 0,15 mm;

— number of sweep cycles: 5;

— sweep rate: 1 octave per min.

The direction of vibration is vertical and the recorder is fastened in its normal position of use.

8.4.2 ***Shock test***

The method given in IEC 68-2-27, shall be used with the details specified below:

— peak acceleration: a) 147 m/s^2 (15 g_n)
b) 490 m/s^2 (50 g_n)

For the peak acceleration in case a) no information is needed. In case b) the manufacturer shall state:

— 490 m/s^2: peak acceleration;

— pulse shape: half-sine;

— number of shocks: three in both directions of three mutually perpendicular axes (total of 18 shocks);

— duration of pulse: 11 ms.

The recorder is mounted so that one of the three shock axes is parallel to the axis of movement of the moving element.

8.4.3 After these tests the recorder shall comply with its accuracy requirements.

9 Information, markings and symbols

9.1 Information on the recorder

The following information shall appear on the recorder:

a) manufacturer's name or mark;

b) designation of the type of recorder;

c) serial number or reference number;

d) nature of the measurand;[2)]

e) nature and rated value(s) of the auxiliary supply(ies);

f) rated value(s) of the measuring range(s) and chart speed(s);[2)]

[2)] This information need not be indelible and may be shown for example on a display.

g) symbol showing that some essential information is given in a separate document (symbol F-33), if relevant;

h) necessary data for using and testing the recorder if the marking on the scale or chart does not coincide with the measurand; if the data cannot be marked sufficiently clearly on the recorder, symbol F-33 shall be used;

i) maximum permissible value of voltage to earth (ground).

9.2 Information in documentation

All information including identification of terminals and means of earthing necessary for correct operation, storage and transport of the recorder and to prove compliance with this part and compliance with the relevant safety requirements (see Table 4, symbol C) shall be provided on the recorder or in the accompanying documentation.

9.3 Information relating to reference conditions and nominal ranges of use

9.3.1 Reference values or reference ranges, as well as nominal ranges of use, corresponding to each influence quantity, shall be indicated.

9.3.2 When any limit of the nominal range of use is the same as the reference value or the adjacent limit of the reference range, the number indicating the reference value or the limit of the reference range shall be repeated for the limit of the nominal range of use.

9.3.3 If a reference value or reference range is marked, it shall be identified by underlining.

9.3.4 The influence quantity shall be identified by the symbol of its unit.

9.3.5 Table 3 shows the significance of the various markings for temperature.

Table 3 — Examples of marking of reference values, reference ranges and nominal ranges of use for temperature

Example	Meaning
23 °C	Reference value: 23 °C Nominal range of use 13 °C to 33 °C
20 °C ... 23 °C ... 30 °C	Reference value: 23 °C Nominal range of use 20 °C to 30 °C
15 °C ... 20 °C ... 23 °C ... 30 °C	Reference range: 20 °C to 23 °C Nominal range of use 15 °C to 30 °C (Permissible variations: from 15 °C to 20 °C and from 23 °C to 30 °C)
20 °C ... 20 °C ... 23 °C ... 30 °C	Reference range: 20 °C to 23 °C Nominal range of use 20 °C to 30 °C (Permissible variation: from 23 °C to 30 °C)

Table 4 — Symbols for marking recorders

Symbols for units of measurement and their prefixes are given in IEC 27. For convenience, the symbols most likely to be needed for marking recorders and accessories and a list of the SI prefixes are given below.

Units and quantities	
Item	**Symbol**
ampere	A
decibel	dB
hertz	Hz
ohm	Ω
second	s (lower case)
siemens	S (upper case)
tesla	T
volt	V (upper case)
voltampere	VA (upper case)
voltampere reactive	var (lower case)
watt	W (upper case)
power factor	cos ϕ or cos φ
degree Celsius	°C
metre	m

SI prefixes		
Item		**Symbol**
exa	10^{18}	E
peta	10^{15}	P
tera	10^{12}	T
giga	10^{9}	G
mega	10^{6}	M (upper case)
kilo	10^{3}	k (lower case)
hecto[a]	10^{2}	h (lower case)
deca[a]	10	da (lower case)
deci[a]	10^{-1}	d (lower case)
centi	10^{-2}	c (lower case)
milli	10^{-3}	m (lower case)
micro	10^{-6}	μ
nano	10^{-9}	n
pico	10^{-12}	P
femto	10^{-15}	f
atto	10^{-18}	a

[a] These items are non-preferred and their use should be avoided.

The symbol of a prefix (if needed) immediately precedes, without a space, the symbol of a unit.

If there is a number, it is followed by a space before the prefix (if any) and the unit.

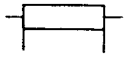
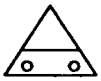
For example: 23 °C 120 mV $12 \cdot 10^{6}$ V or 12 MV

Table 4 — Symbols for marking recorders

B — Nature of measurand		
No.	**Item**	**Symbol**
B-1	Direct current circuit and/or d.c. responding measuring element	 (5031)[b]
B-2	Alternating current circuit and/or a.c. responding measuring element	 (5032)[b]
B-3	Direct and/or alternating current circuit and/or d.c. and a.c. responding measuring element	 (5033)[b]

E — Accuracy class		
No.	**Item**	**Symbol**
E-10	Class index (e.g. 1) when the fiducial value corresponds to the span	| 1 |

Table 4 — Symbols for marking recorders

F — General symbols (see also IEC 417 and IEC 617)		
No.	**Item**	**Symbol**
F-18	Non-insulated thermo-couple (thermal converter)	
F-19	Insulated thermo-couple (thermal converter)	
F-23	Shunt	
F-30	Magnetic field strength expressed in kiloamperes per metre (e.g. 2 kA/m) producing a variation corresponding to the class index	 kA/m
F-31	Earth (ground) terminal (general symbol)	 (5017)[ba]
F-32	Zero (span) adjuster	
F-33	Refer to a separate document	
F-42	Frame or chassis terminal	 (5020)[b]
F-43	Protective earth (ground) terminal	 (5019)[b]
F-44	Noiseless earth (ground) terminal	 (5018)[b]
F-45	Signal low terminal	
F-46	Positive terminal	 (5005)[b]
F-47	Negative terminal	(5006)[b]
F-48	Resistance range setting control	 (5174)[b]
F-49	Overload protection device fitted	 (5175)[b]
F-50	Overload protection device reset control	 (5176)[b]

[a] The use of symbol F-31 is deprecated. One of the more explicit symbols, F-42, F-43, F-44 or F-45 should be used instead.
[b] Numbers identified by * are the reference numbers of the symbols in IEC 417. The number is not part of the symbol.

10 Markings and symbols for terminals

10.1 Requirements for markings

10.1.1 The markings shall be applied on, or adjacent to, the relevant terminal.

10.1.2 If there is insufficient space adjacent to a terminal for the marking specified, a permanently attached name-plate shall be provided, having details of the terminals and identifying them in an unambiguous way.

10.1.3 The markings shall be indelible, remain legible and be of a colour which contrasts with the background, or shall be moulded.

10.1.4 A marking shall not be applied to a removable part of a terminal.

10.1.5 If markings are applied to a cover over several terminals, it shall not be possible to fit the cover so that the markings may be misinterpreted.

10.1.6 When a diagram of connections is supplied, the marking for a terminal shall be identical to that on the diagram of connections relating to that terminal.

10.2 Earthing (grounding) terminals

10.2.1 Terminals which are required to be connected to a protective earth (ground) for reasons of safety shall be marked with symbol F-43 (Table 4).

10.2.2 Terminals which are required to be connected to a noiseless earth (ground) to prevent impairment of performance shall be marked with symbol F-44 (Table 4).

10.2.3 Terminals which are connected to accessible conductive material but which are not necessarily required to be connected to earth (ground) shall be marked with symbol F-42 (Table 4).

10.3 Measuring circuit terminals

If a terminal of the measuring circuit is intended to be kept at, or near to earth (ground) potential (for example, for safety or functional reasons), it shall either be marked with a capital N if it is intended to be connected to the neutral conductor of an a.c. supply circuit, or it shall be marked with symbol F-45 (Table 4) in all other circumstances.

These markings are additional to, and shall follow, any other markings prescribed for every relevant terminal.

11 Tests to prove compliance with this part

11.1 Performance

The performance of recorders specified in this part may be verified using the tests given in IEC 51-9 and IEC 1143-2 (under consideration).

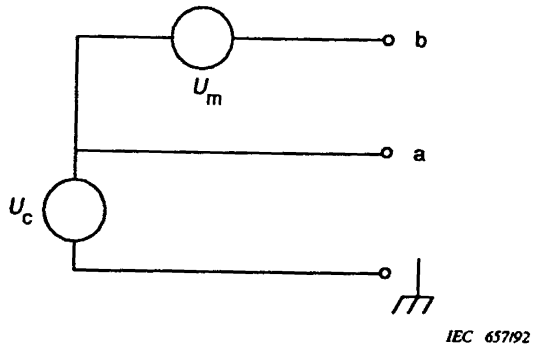
Annex A (normative)
Determination of the influence of parasitic input quantities

Figure 1 and Figure 2 are examples only.

Connection of earth (ground) and screen, and unused inputs, if any, shall be in accordance with the manufacturer's instructions.

A.1 Common mode interference (between measuring circuit and earth)

This test is made in accordance with the circuit shown in Figure A.1.



a, b = input terminals

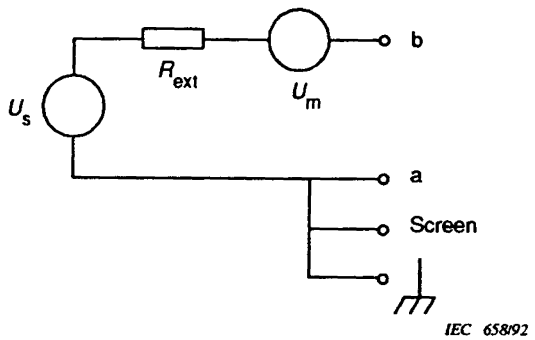
U_c = parasitic voltage between measuring circuit and earth (ground)

U_m = measured voltage

Figure A.1 — Circuit diagram for the common mode test

A.2 Series mode interference

This test is made in accordance with the circuit shown in Figure A.2.



a, b = input terminals

U_s = series mode parasitic voltage

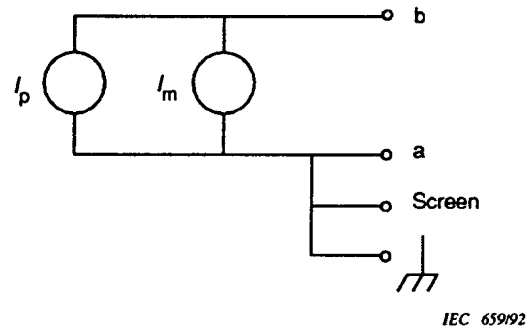
U_m = measured voltage

R_{ext} = external resistance

Figure A.2 — Circuit diagram for the series mode test

A.3 Parallel mode interference

This test is made in accordance with the circuit shown in Figure A.3.



a, b = input terminals

I_p = parallel mode parasitic current

I_m = measured current

Figure A.3 — Circuit diagram for the parallel mode test

Annex ZA (normative)
Other international publications quoted in this standard with the references of the relevant European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

NOTE When the international publication has been modified by CENELEC Common modifications, indicated by (mod), the relevant EN/HD applies.

IEC publication	Date	Title	EN/HD	Date
27	series	*Letter symbols to be used in electrical technology*	HD 245	series
51-1	1984	*Direct acting indicating analogue electrical measuring instruments and their accessories — Part 1: Definitions and general requirements common to all parts*	EN 60051-1	1989
51-2	1984	*Part 2: Special requirements for ammeters and voltmeters*	EN 60051-2	1989
51-3	1984	*Part 3: Special requirements for watermeters and varmeters*	EN 60051-3	1989
51-4	1984	*Part 4: Special requirements for frequency meters*	EN 60051-4	1989
51-5	1985	*Part 5: Special requirements for phase meters, power factor meters and synchroscopes*	EN 60051-5	1989
51-6	1984	*Part 6: Special requirements for ohmmeters (impedance meters) and conductance meters*	EN 60051-6	1989
51-7	1984	*Part 7: Special requirements for multi-function instruments*	EN 60051-7	1989
51-8	1984	*Part 8: Special requirements for accessories*	EN 60015-8	1989
51-9	1988	*Part 9: Recommended test methods*	EN 60015-9	1989
68-2-6	1982	*Environmental testing — Part 2: Tests Test Fc and guidance: Vibration (sinusoidal)*	HD 323.2.6 S2[a]	1988
68-2-27	1987	*Test Ea and guidance: Shock*	EN 60068-2-27	1993
160	1963	*Standard atmospheric conditions for test purposes*	—	—
417	1973	*Graphical symbols for use on equipment Index, survey and compilation of the single sheets*	HD 243 S10[a]	1993
473	1974	*Dimensions for panel-mounted indicating and recording electrical measuring instruments*	—	—
617-2	1983	*Graphical symbols for diagrams — Part 2: Symbol elements, qualifying symbols and other symbols having general application*	—	—
1010	series	*Safety requirements for electrical equipment for measurement, control and laboratory use*	EN 61010	series

[a] HD 323.2.6 S2 includes A1:1983 + A2:1985 to IEC 68-2-6.
HD 243 S10 includes supplements A:1974 to K:1991 to IEC 417.

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List of references

See national foreword.

BS EN 61143-1:1994 IEC 1143-1: 1992

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