



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS C 1102-1 : 2007

(JEMIMA/JSA)

**Direct acting indicating analogue
electrical measuring instruments
and their accessories—
Part 1 : Definitions and general
requirements common to all parts**

ICS 17.220.20

Reference number : JIS C 1102-1 : 2007 (E)

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Date of Establishment: 1997-10-20

Date of Revision: 2007-08-20

Date of Public Notice in Official Gazette: 2007-08-20

Investigated by: Japanese Industrial Standards Committee
Standards Board

Technical Committee on Testing and Measurement
Technology

JIS C 1102-1:2007, First English edition published in 2008-06

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Electric Measuring Instruments Manufacturers' Association (JEMIMA)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently **JIS C 1102-1 : 1997** is replaced with this Standard.

This **JIS** document is protected by the Copyright Law.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

JIS C 1102 consists of the following 9 parts 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 shall be read in conjunction with this Part 1.

Parts 1 to 8 are arranged in the same format where corresponding clause numbers are standardized.

In addition, tables, figures and Annexes are added with tree numbers of each standard to make the parts identifiable. This editing will assist the user of **JIS C 1102** 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

Introduction

This Japanese Industrial Standard has been prepared based on the fifth edition of **IEC 60051-1** published in 1997 with some modifications of the technical contents.

The portions underlined with dots are the matters in which the contents of the original International Standard have been modified. A list of modifications with the explanations is given in Annex JB.

1 General

1.1 Scope

This Standard applies to direct acting indicating electrical measuring instruments having an analogue display, 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.

If other accessories are associated with instruments, this Standard is applicable to the combination of the instrument and the accessory provided that the adjustments have been made for the combination.

This Standard also applies to a 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.

This Standard also applies to instruments and accessories having electronic devices in their measuring and/or auxiliary circuits.

This Standard does not apply to special purpose instruments which are covered by their own **JIS** standards.

This Standard does not apply to special purpose devices which are covered by their own **JIS** standards when they are used as accessories.

This Standard does not contain either requirements for protection against environmental conditions or the relevant tests. However, when necessary, and then only by agreement between the manufacturer and the user, tests to approximate the conditions of use may be selected from **JIS C 60068**.

This Standard does not specify requirements concerning dimensions of instruments or accessories (for the former, see **IEC 61554**).

NOTE 1 For the dimensions of instruments, see **JIS C 1103**.

NOTE 2 This Standard specifies general requirements relating to characteristics of direct acting indicating analogue electrical measuring instruments and does not purport to address the conformity assessment by itself.

NOTE 3 The International Standard corresponding to this Standard is as follows.

IEC 60051-1:1997 *Direct acting indicating analogue electrical measuring instruments and their accessories—Part 1: Definitions and general requirements common to all parts* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

1.2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. If the indication of the year is given to the referred standard, the edition of indicated year applies but the revision (including amendments) made thereafter does not apply. The normative references without the indication of the year apply only to the most recent editions (including amendments).

JIS C 0617-2 *Graphical symbols for diagrams—Part 2: Symbol elements, qualifying symbols and other symbols having general application*

NOTE : Corresponding International Standard: IEC 60617-2 *Graphical symbols for diagrams—Part 2: Symbol elements, qualifying symbols and other symbols having general application* (IDT)

JIS C 1010-1 *Safety requirements for electrical equipment for measurement, control, and laboratory use—Part 1: General requirements*

NOTE : Corresponding International Standard: IEC 61010-1 *Safety requirements for electrical equipment for measurement, control, and laboratory use—Part 1: General requirements* (MOD)

JIS C 1102-9 *Direct acting indicating analogue electrical measuring instruments and their accessories Part 9: Recommended test methods*

NOTE : Corresponding International Standard: IEC 60051-9 *Direct acting indicating analogue electrical measuring instruments and their accessories. Part 9: Recommended test methods* (IDT)

JIS C 60068-2-6 *Environmental testing Part 2: Tests—Test Fc: Vibration (sinusoidal)*

NOTE : Corresponding International Standard: IEC 60068-2-6 *Environmental testing—Part 2: Tests—Test Fc: Vibration (sinusoidal)* (IDT)

JIS C 60068-2-27 *Basic environmental testing procedures Part 2: Tests, Test Ea and guidance: Shock*

NOTE : Corresponding International Standard: IEC 60068-2-27 *Environmental testing. Part 2: Tests. Test Ea and guidance: Shock* (IDT)

IEC 60027 *Letter symbols to be used in electrical technology*

IEC 60050 (301), (302), (303):1983 *International Electrotechnical Vocabulary (IEV)—Chapter 301: General terms on measurements in electricity—Chapter 302: Electrical measuring instruments—Chapter 303: Electronic measuring instruments*

NOTE : This International Standard was withdrawn in 2001 and replaced with
IEC 60050-300:2001.

IEC 60417:1973 *Graphical symbols for use on equipment*

2 Definitions

For the purpose of this Standard, terms as defined in **IEC 60050** apply, together with the following additional terms.

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

2.1 General terms

2.1.1 electrical measuring instrument

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

2.1.2 analogue display instrument

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

NOTE : 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 instrument.

2.1.3 indicating instrument

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

NOTE : 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.

2.1.4 direct acting indicating instrument

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

2.1.5 electronic measuring instrument

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

2.1.6 single function instrument

an instrument intended for the measurement of one kind of quantity only

2.1.7 multi-function instrument

an 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)

2.1.8 fixed instrument

an instrument designed to be permanently mounted and which is intended to be connected to (an) external circuit(s) by means of permanently installed leads

2.1.9 portable instrument

an instrument specifically designed to be carried out by hand

NOTE : The instrument is intended to be connected and disconnected by the user.

2.1.10 polyphase instrument

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

2.1.11 balanced load polyphase instrument

a polyphase instrument for use in a balanced polyphase system

This does not include a single-phase wattmeter scaled in terms of polyphase power.

2.1.12 instrument with magnetic screen

an instrument shielded by ferro-magnetic material from the influence of a magnetic field of external origin

2.1.13 astatic instrument

an instrument in which the measuring element is so constructed as to be unaffected by a uniform magnetic field of external origin

2.1.14 instrument with electric screen

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

2.1.15 accessory

an 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

2.1.15.1 interchangeable accessory

an accessory having its own properties and accuracy, these being independent of those of the instrument 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 instrument. A shunt whose adjustment takes into account an instrument current which is not negligible and which is known, is considered to be interchangeable.

2.1.15.2 accessory of limited interchangeability

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

2.1.15.3 non-interchangeable accessory

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

2.1.16 shunt

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

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

2.1.17 series resistor (impedance)

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

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

2.1.18 instrument lead

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

2.1.19 calibrated instrument lead

an instrument lead whose resistance has a specified value

NOTE : A calibrated instrument lead is considered as being an interchangeable accessory of a measuring instrument.

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

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

2.1.21 ripple content of a quantity

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

2.1.22 peak factor

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

2.2 Description of instruments according to their method of operation

2.2.1 permanent-magnet moving-coil instrument

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

2.2.2 moving-magnet instrument

an 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: The instrument can have more than one coil.

2.2.3 moving-iron instrument

an 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

2.2.4 polarized moving-iron instrument

an 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

2.2.5 electrodynamic instrument

an 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

2.2.6 ferrodynamic instrument (iron-cored electrodynamic instrument)

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

2.2.7 induction instrument

an instrument which operates by the interaction of the magnetic field(s) of (a) fixed a.c. electromagnet(s) with eddy currents which are induced in (a) movable conductive element(s) in the magnetic field(s)

2.2.8 thermal instrument (electrothermal instrument)

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

2.2.8.1 bimetallic instrument

a 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

2.2.8.2 thermocouple instrument

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

NOTE: The e.m.f. is often measured using a permanent-magnet moving-coil instrument.

2.2.9 rectifier instrument

an 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

2.2.10 electrostatic instrument

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

2.2.11 pointer-type frequency meter

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

2.2.12 vibrating-reed frequency meter

an 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

2.2.13 phase meter

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

Such an instrument measures:

- the phase angle between a voltage and another voltage or
- the phase angle between a current and another current or
- the phase angle between a voltage and a current.

2.2.14 power factor meter

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

In practice, power factor meters indicate the cosine of the phase angle between a current and a related voltage.

2.2.15 ratiometer (quotientmeter)

an instrument for measuring the ratio (quotient) of two quantities

2.2.16 R.M.S.-responding instrument

an 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

2.3 Constructional features of instruments

2.3.1 measuring circuit (of an instrument)

the 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)

2.3.1.1 current circuit

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

NOTE : 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.

2.3.1.2 voltage circuit

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

NOTE : 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).

2.3.2 external measuring circuit

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

2.3.3 auxiliary circuit

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

2.3.3.1 auxiliary supply

an auxiliary circuit which provides electrical energy

2.3.4 measuring element

the 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

2.3.5 moving element

the moving part of a measuring element

2.3.6 indicating device

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

2.3.7 index

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

2.3.8 scale

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

2.3.8.1 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

2.3.8.2 zero scale mark

the mark on the dial associated with the figure zero

2.3.8.3 scale division

the distance between any two consecutive scale marks

2.3.9 scale numbers

the series of numbers which are associated with the scale marks

2.3.10 dial

the surface which carries the scale and other marks and symbols

2.3.11 mechanical zero

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

This may or may not coincide with the zero scale mark.

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

In instruments without restoring torque the mechanical zero is indeterminate.

2.3.11.1 mechanical zero adjuster

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

2.3.11.2 mechanical span adjuster

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

2.3.12 electrical zero

the 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

2.3.12.1 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

2.3.12.2 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

2.4 Characteristic features of instruments

2.4.1 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 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.