IEC 61869-1

Edition 2.0 2023-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Instrument transformers – Part 1: General requirements

Transformateurs de mesure – Partie 1: Exigences générales



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Instrument transformers – Part 1: General requirements

Transformateurs de mesure – Partie 1: Exigences générales

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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INSTRUMENT TRANSFORMERS –

Part 1: General requirements

FOREWORD

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This second edition cancels and replaces the first edition published in 2007 and IEC 61869-6:2016. This edition constitutes a technical revision.

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

a) merger with IEC 61869-6:2016;
b) new scope: equipment for HV applications with a nominal voltage > 1 kV AC or 1,5 kV DC;
c) new classification of some special tests as type tests or routine test;
d) additional type tests, additional special tests and new clause for commissioning tests;
e) new annexes E, F, G and I.

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

Draft	Report on voting
38/718/FDIS	38/722/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61869 series, published under the general title *Instrument transformers*, can be found on the IEC website. An overview of the planned or existing set of standards at the date of publication of this document is given below.

The updated list of standards issued by IEC TC 38 is available at the website: https://www.iec.ch

Product family standard	**Product standard**	**Title**
61869-1 General requirements	61869-2	Additional requirements for current transformers
	61869-3	Additional requirements for inductive voltage transformers
	61869-4	Additional requirements for combined transformers
	61869-5	Additional requirements for capacitor voltage transformers
	61869-7	Additional requirements for low-power voltage transformers
	61869-8	Additional requirements for low-power current transformers
	61869-9	Digital interface for instrument transformers
	61869-10	Additional requirements for current sensors
	61869-11	Additional requirements for voltage sensors
	61869-12	Additional requirements for combined low-power instrument transformers
	61869-13	Stand-alone merging unit (SAMU)
	61869-14	Additional requirements for current transformers for DC applications
	61869-15	Additional requirements for voltage transformers for DC applications
	61869-16	TEDS (transducer electronic data sheet) for instrument transformers
	61869-99	Glossary

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- withdrawn,
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INTRODUCTION

This document is the first revision of IEC 61869-1, defining common requirements for instrument transformers, applicable to all types or technologies.

Furthermore, the document is the result of a merger of IEC 61869-1:2007 (*General requirements*) and IEC 61869-6:2016 (*Additional general requirements for low-power instrument transformers*) with the aim of having one single document and simplify the comprehension for the reader of LPIT product-specific standards.

The main modifications of this revision are listed below:

- new scope: equipment for HV applications with a nominal voltage > 1 kV AC or 1,5 kV DC;
- transfer of the definitions to the TC 38 Glossary IEC 61869-99;
- ratings:
  - addition of HV insulation levels above 800 kV;
  - new DC insulation resistance requirements for secondary terminals;
  - additional accuracy class extensions for harmonics;
- design and construction:
  - additional mechanical requirements for EHV applications;
  - clarification of the altitude correction for external insulation and dielectric tests;
  - multiple chopped impulse test: definition of maximum gas-in-oil level before test;
  - internal arc fault protection: simplification of the acceptance criteria;
  - new requirements for storage climatic conditions withstand capability for LPIT;
- type tests:
  - temperature rise test: more accurate definition of the test duration;
  - lightning impulse test: new test procedure (15 impulses) for gas-insulated and resin-insulated instrument transformers, for U_m ≥ 300 kV;
  - switching impulse test: to be performed in both polarities in case of gas-insulated instrument transformers;
  - chopped wave impulse test: moved from special test to type test;
  - test for accuracy: to be performed with regard to the temperature range and frequency;
  - mechanical test: moved from special test to type test;
  - new specification for storage climatic environmental tests;
- routine tests:
  - partial discharge measurement: addition of record of PD inception voltage and extinction voltage;
  - measurement of capacitance and tanδ: moved from special test to routine test;
- special tests:
  - transmitted overvoltage test: improved test procedure;
  - internal arc fault test: clarified test procedure;
  - new insulation resistance measurement on secondary terminals;
  - new test for resin insulated instrument transformers operating at low temperature;
  - vibration test: improvement and addition of a shock test for parts mechanically coupled to a circuit-breaker;
  - optional tests for accuracy versus harmonics and for anti-aliasing;

- commissioning tests (new clause):
  - new installation inspection;
  - gas dew point test moved from special test to commissioning tests;
  - new recommended insulation test on LV connection up to the LV cubicle;
- rules for transport, storage, erection, operation and maintenance:
  - new mandatory rules for user and manufacturer;
  - new conditions for transportation and storage;
- new annexes:
  - Annex E (informative): technique used in temperature rise test of transformers to determine the thermal time constant by an experimental estimation;
  - Annex F (informative): guidance for the extension of validity of type tests and special tests;
  - Annex G (informative): guidance for the calculation of equivalent diameter in case of irregular shape of insulating part;
  - Annex I (normative): seismic qualification of instrument transformers.

INSTRUMENT TRANSFORMERS –

Part 1: General requirements

1 Scope

This part of IEC 61869 is applicable to newly manufactured instrument transformers intended for applications where the nominal voltage is higher than 1 kV AC or 1,5 kV DC, with an analogue or a digital secondary signal for measuring, protection and control purposes, with rated frequencies from 15 Hz to 400 Hz, or for DC applications.

NOTE 1 A bushing type current transformer, although having no primary insulation level for itself is often placed on a system with a nominal voltage > 1 kV AC or > 1,5 kV DC and therefore falls within the scope of this document. Example: CT placed around an HV bushing or a cable.

The general requirements for instrument transformers for applications in LV systems (nominal voltage ≤ 1 kV AC or ≤ 1,5 kV DC) are covered by IEC 61869-201.

This part of IEC 61869 is a product family standard and covers general requirements only. For each type of instrument transformer, the product standard is composed of this document and the relevant specific product standard.

This part of IEC 61869 contains the requirements for the limits of the errors both for analogue and digital secondary signals. The other characteristics of a digital interface for instrument transformer are standardised in IEC 61869-9 as an application of the IEC 61850 horizontal standard series, covering communication networks and systems for power utility automation.

This part of IEC 61869 considers bandwidth requirements. The accuracy requirements on harmonics and requirements for the anti-aliasing filter are specified in 5.7.

In the case of an LPIT, the general block diagram of single-phase devices is given in Figure 1.

According to the technology, it is not always necessary that all parts described in Figure 1 be included in the instrument transformer.

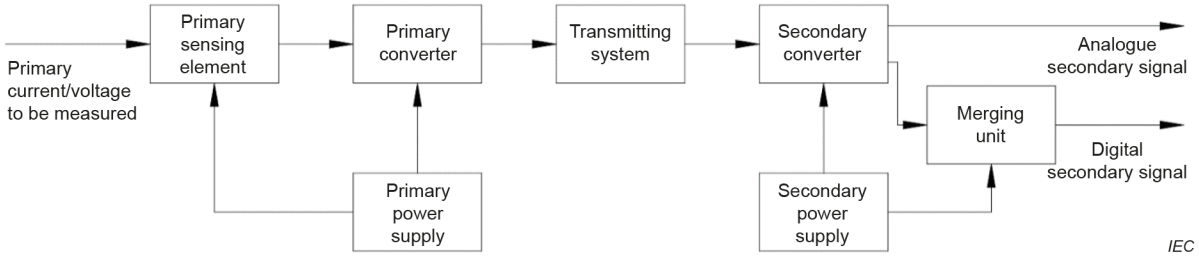


Figure 1 – General block diagram of single-phase LPITs

NOTE 2 A secondary power supply can be combined with a primary power supply or with a power supply of other instrument transformers.

2 Normative references

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

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-11, *Environmental testing – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-17, *Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-47, *Environmental testing – Part 2-47: Tests – Mounting of specimens for vibration impact and similar dynamic tests*

IEC 60068-2-57:2013, *Environmental testing – Part 2-57: Tests – Test Ff: Vibration – Time-history and sine-beat method*

IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60068-3-3:2019, *Environmental testing – Part 3-3: Supporting documentation and guidance – Seismic test methods for equipment*

IEC 60071-1:2019, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60071-2:2018, *Insulation co-ordination – Part 2: Application guidelines*

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

IEC 60270:2000, *High-voltage test techniques – Partial discharge measurements*
IEC 60270:2000/AMD1:2015

IEC 60296, *Fluids for electrotechnical applications – Mineral insulating oils for electrical equipment*

IEC 60376, *Specification of technical grade sulphur hexafluoride (SF_6) and complementary gases to be used in its mixtures for use in electrical equipment*

IEC 60455 (all parts), *Resin based reactive compounds used for electrical insulation*

IEC 60475, *Method of sampling insulating liquids*

IEC 60480, *Specifications for the re-use of sulphur hexafluoride (SF_6) and its mixtures in electrical equipment*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60603-7-1, *Connectors for electronic equipment – Part 7-1: Detail specification for 8-way, shielded, free and fixed connectors*

IEC 60695-1-10, *Fire hazard testing – Part 1-10: Guidance for assessing the fire hazard of electrotechnical products – General guidelines*

IEC 60695-1-11, *Fire hazard testing – Part 1-11: Guidance for assessing the fire hazard of electrotechnical products – Fire hazard assessment*

IEC 60794-2:2017, *Optical fibre cables – Part 2: Indoor cables – Sectional specification*

IEC 60794-3, *Optical fibre cables – Part 3: Outdoor cables – Sectional specification*

IEC TS 60815-1:2008, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles*

IEC TS 60815-2:2008, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 2: Ceramic and glass insulators for a.c. systems*

IEC TS 60815-3:2008, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems*

IEC 60867, *Insulating liquids – Specifications for unused liquids based on synthetic aromatic hydrocarbons*

IEC TR 61000-4-1, *Electromagnetic compatibility (EMC) – Part 4-1: Testing and measurement techniques – Overview of IEC 61000-4 series*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*
IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-9, *Electromagnetic compatibility (EMC) – Part 4-9: Testing and measurement techniques – Impulse magnetic field immunity test*

IEC 61000-4-10, *Electromagnetic compatibility (EMC) – Part 4-10: Testing and measurement techniques – Damped oscillatory magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase*

IEC 61000-4-13, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at AC power port, low frequency immunity tests*

IEC 61000-4-16, *Electromagnetic compatibility (EMC) – Part 4-16: Testing and measurement techniques – Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz*

IEC 61000-4-17, *Electromagnetic compatibility (EMC) – Part 4-17: Testing and measurement techniques – Ripple on DC input power port immunity test*

IEC 61000-4-18:2019, *Electromagnetic compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory wave immunity test*

IEC 61000-4-29, *Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on DC input power port immunity tests*

IEC 61000-6-4:2018, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61076-2-101, *Connectors for electronic equipment – Product requirements – Part 2-101: Circular connectors – Detail specification for M12 connectors with screw-locking*

IEC 61083-1, *Instruments and software used for measurement in high-voltage and high-current tests – Part 1: Requirements for instruments for impulse tests*

IEC 61099, *Insulating liquids – Specifications for unused synthetic organic esters for electrical purposes*

IEC 61181, *Mineral oil-filled electrical equipment – Application of dissolved gas analysis (DGA) to factory tests on electrical equipment*

IEC 61462, *Composite hollow insulators – Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1 000 V – Definitions, test methods and acceptance criteria and design recommendations*

IEC 61850-7-4, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes*

IEC 61869-9:2016, *Instrument transformers – Part 9: Digital interface for instrument transformers*

IEC 61869-99, *Instrument transformers: Glossary*

IEC 62155, *Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V*

IEC 62217:2012, *Polymeric HV insulators for indoor and outdoor use – General definitions, test methods and acceptance criteria*

IEC 62271-4:2022, *High-voltage switchgear and controlgear – Part 4: Handling procedures for gases for insulation and/or switching*

IEC 62271-100, *High-voltage switchgear and controlgear – Part 100: Alternating-current circuit-breakers*

IEC 62271-203:2022, *High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV*

IEC 62770, *Fluids for electrotechnical applications – Unused natural esters for transformers and similar electrical equipment*

IEC 63012, *Insulating liquids – Unused modified or blended esters for electrotechnical applications*

CISPR TR 18-2, *Radio interference characteristics of overhead power lines and high-voltage equipment – Part 2: Methods of measurement and procedure for determining limits*

ISO/IEC/IEEE 21451-4, *Information technology – Smart transducer interface for sensors and actuators – Part 4: Mixed-mode communication protocols and Transducer Electronic Data Sheet (TEDS) formats*

ISO 4628-3, *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 3: Assessment of degree of rusting*

ISO 22479, *Corrosion of metals and alloys – Sulfur dioxide test in a humid atmosphere (fixed gas method)*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 61869-99 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/;
- ISO Online browsing platform: available at https://www.iso.org/obp.

3.2 Symbols and abbreviated terms

ADC	analogue-to-digital converter
AIS	air-insulated switchgear
CT	current transformer
CVT	capacitor voltage transformer
EIT	electronic IT
EMC	electromagnetic compatibility
F	mechanical load
f_r	rated frequency
F_{rel}	relative leakage rate

F_V	rated voltage factor
GIS	gas-insulated switchgear
I_{arc}	rated internal arc fault current
I_{cth}	rated continuous thermal current
I_{dyn}	rated dynamic current
I_{pr}	rated primary current
I_{psc}	rated short-circuit current
I_{sr}	rated secondary current
I_{th}	rated short-time thermal current
IED	intelligent electronic device
IT	instrument transformer
K_r	rated transformation ratio
k_{se}	superelevation factor
LPCT	low-power current transformer
LPIT	low-power instrument transformer
LPVT	low-power voltage transformer
MU	merging unit
PD	partial discharge
RMS	root-mean-square
SAMU	stand-alone merging unit
S_r	rated output – rated output power
t_{dr}	rated delay time
U_m	highest voltage for equipment
U_{pr}	rated primary voltage
U_{sr}	rated secondary voltage
U_{sys}	highest voltage of the system
VT	voltage transformer
Z_{br}	rated burden
ZPA	zero period acceleration
$\Delta\varphi$	phase displacement
ε	ratio error
ε_c	composite error
φ_e	phase error

4 Normal and special environmental conditions

4.1 General

Unless otherwise specified, instrument transformers are intended to be used at their rated characteristics under the normal environmental conditions listed in 4.2.

If the actual environmental conditions differ from these normal environmental conditions, instrument transformers shall be designed to comply with special environmental conditions as required by the purchaser.