

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Instrument transformers –
Part 3: Additional requirements for inductive voltage transformers
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Transformateurs de mesure –
Partie 3: Exigences supplémentaires concernant les transformateurs inductifs
de tension
IEC 61869-3:2011
<https://standards.iteh.ai/catalog/standards/sist/501e216f-ba61-44ad-9152-b85514d36f62/iec-61869-3-2011>



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IEC 61869-3

Edition 1.0 2011-07

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Part 3: Additional requirements for inductive voltage transformers**

**Transformateurs de mesure –
Partie 3: Exigences supplémentaires concernant les transformateurs inductifs
de tension**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

U

ICS 17.220.20

ISBN 978-2-88912-544-9

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

INSTRUMENT TRANSFORMERS –

Part 3: Additional requirements for inductive voltage transformers

FOREWORD

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This International Standard IEC 61869-3 has been prepared by subcommittee 38: Instrument transformers.

This standard replaces IEC 60044-2: Inductive Voltage Transformers.

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

FDIS	Report on voting
38/410/FDIS	38/413/RVD

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

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

This standard is Part 3 of IEC 61869, published under the general title *Instrument transformers*.

This part 3 is to be read in conjunction with, and is based on, IEC 61869-1, *General Requirements* - first edition (2007)- however the reader is encouraged to use its most recent edition.

This Part 3 follows the structure of IEC 61869-1 and supplements or modifies its corresponding clauses.

When a particular clause/subclause of Part 1 is not mentioned in this Part 3, that clause/subclause applies as far as is reasonable. When this standard states “addition”, “modification” or “replacement”, the relevant text in Part 1 is to be adapted accordingly.

For additional clauses, subclauses, figures, tables, annexes or notes, the following numbering system is used:

- clauses, subclauses, tables, figures and notes that are numbered starting from 301 are additional to those in Part 1;
- additional annexes are lettered 3A, 3B, etc.

An overview of the planned set of standards at the date of publication of this document is given below. The updated list of standards issued by IEC TC38 is available at the website: www.iec.ch.

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[IEC 61869-3:2011](https://standards.iteh.ai/catalog/standards/sist/301e2161-babf-44ad-9132-b85514d36f62/iec-61869-3-2011)

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PRODUCT FAMILY STANDARDS	PRODUCT STANDARD	PRODUCTS	OLD STANDARD
61869-1 GENERAL REQUIREMENTS FOR INSTRUMENT TRANSFORMERS		61869-2	ADDITIONAL REQUIREMENTS FOR CURRENT TRANSFORMERS 60044-1 60044-6
		61869-3	ADDITIONAL REQUIREMENTS FOR INDUCTIVE VOLTAGE TRANSFORMERS 60044-2
		61869-4	ADDITIONAL REQUIREMENTS FOR COMBINED TRANSFORMERS 60044-3
		61869-5	ADDITIONAL REQUIREMENTS FOR CAPACITIVE VOLTAGE TRANSFORMERS 60044-5
	61869-6 ADDITIONAL GENERAL REQUIREMENT FOR ELECTRONIC INSTRUMENT TRANSFORMERS AND LOW POWER STAND ALONE SENSORS	61869-7	ADDITIONAL REQUIREMENTS FOR ELECTRONIC VOLTAGE TRANSFORMERS 60044-7
		61869-8	ADDITIONAL REQUIREMENTS FOR ELECTRONIC CURRENT TRANSFORMERS 60044-8
		61869-9	DIGITAL INTERFACE FOR INSTRUMENT TRANSFORMERS
		61869-10	ADDITIONAL REQUIREMENTS FOR LOW-POWER STAND ALONE CURRENT SENSORS
		61869-11	ADDITIONAL REQUIREMENTS FOR LOW-POWER STAND ALONE VOLTAGE SENSOR 60044-7
		61869-12	ADDITIONAL REQUIREMENTS FOR COMBINED ELECTRONIC INSTRUMENT TRANSFORMER OR COMBINED STAND ALONE SENSORS
		61869-13	STAND ALONE MERGING UNIT

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

INSTRUMENT TRANSFORMERS –

Part 3: Additional requirements for inductive voltage transformers

1 Scope

This part of IEC 61869 applies to new inductive voltage transformers for use with electrical measuring instruments and electrical protective devices at frequencies from 15 Hz to 100 Hz.

NOTE 301 Requirements specific to three-phase voltage transformers are not included in this standard but, so far as they are relevant, the requirements in clauses 4 to 10 apply to these transformers and a few references to them are included in those clauses (e.g. see 3.1.303, 5.301.1, 5.301.2, 5.5.301, 6.13.301.1 and Table 304).

All the transformers shall be suitable for measuring purposes, but, in addition, certain types may be suitable for protection purposes. Transformers for the dual purpose of measurement and protection shall comply with all clauses of this standard.

2 Normative references

Clause 2 of IEC 61869-1:2007 is applicable with the following additions:

IEC 60028, *International Standard of resistance for copper*

IEC 60038, *IEC standard voltages*

[IEC 61869-3:2011](#)

IEC 61869-1:2007, *Instrument transformers – Part 1: General requirements*

3 Terms, definitions and abbreviations

For the purposes of this document, the terms and definitions in IEC 61869-1:2007 apply with the following additions:

3.1 General definitions

3.1.301

voltage transformer

instrument transformer in which the secondary voltage, in normal conditions of use, is substantially proportional to the primary voltage and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections

[IEC 60050-321:1986, 321-03-01]

3.1.302

unearthed voltage transformer

voltage transformer which has all parts of its primary winding, including terminals, insulated from earth to a level corresponding to its rated insulation level

3.1.303

earthed voltage transformer

single-phase voltage transformer which is intended to have one end of its primary winding directly earthed or a three-phase voltage transformer which is intended to have the star-point of its primary winding directly earthed

3.1.304**measuring voltage transformer**

voltage transformer intended to transmit an information signal to measuring instruments, integrating meters and similar apparatus

[IEC 60050-321:1986 , 321-03-04 modified]

3.1.305**protective voltage transformer**

voltage transformer intended to transmit an information signal to electrical protective and control devices

[IEC 60050-321:1986 , 321-03-05]

3.1.306**primary winding**

winding to which the voltage to be transformed is applied

3.1.307**secondary winding**

winding which supplies the voltage circuits of measuring instruments, meters, relays or similar apparatus

3.1.308**residual voltage winding**

winding of a single-phase voltage transformer intended, in a set of three single-phase transformers, for connection in broken delta for the purpose of:

- a) producing a residual voltage under earth-fault conditions;
- b) damping of relaxation oscillations (ferro-resonances).

3.2 Definitions related to dielectric ratings**3.2.301****rated primary voltage**
 U_{pr}

value of the primary voltage which appears in the designation of the transformer and on which its performance is based

[IEC 60050-321:1986, 321-01-12 modified]

3.2.302**rated secondary voltage**
 U_{sr}

value of the secondary voltage which appears in the designation of the transformer and on which its performance is based

[IEC 60050-321:1986, 321-01-16 modified]

3.2.303**rated voltage factor**
 F_v

multiplying factor to be applied to the rated primary voltage to determine the maximum voltage at which a transformer must comply with the relevant thermal requirements for a specified time and with the relevant accuracy requirements

3.4 Definitions related to accuracy

3.4.3

ratio error

 ε

Definition 3.4.3 of IEC 61869-1:2007 is applicable with the following additional text:

The ratio error (voltage error), expressed in per cent, is given by the formula:

$$\varepsilon = \frac{k_r \times U_S - U_P}{U_P} \times 100 \text{ [%]}$$

where

k_r is the rated transformation ratio;

U_P is the actual primary voltage;

U_S is the actual secondary voltage when U_P is applied under the conditions of measurement.

3.5 Definitions related to other ratings

3.5.301

thermal limiting output

value of the apparent power at rated voltage which can be taken from a secondary winding without exceeding the limits of temperature rise.

NOTE 301 In this condition the limits of voltage error and phase displacement, for all secondary windings, most probably may be exceeded.

NOTE 302 In the case of more than one secondary winding, the thermal limiting output is to be given separately.

3.7 Index of abbreviations

IEC 61869-3:2011

<https://standards.iteh.ai/catalog/standards/sist/301e2161-babf-44ad-9132-693f4b5a21cc-61869-3-2011>

Subclause 3.7 of IEC 61869-1 is replaced by the following:

IT	Instrument Transformer
CT	Current Transformer
CVT	Capacitive Voltage Transformer
VT	Voltage Transformer
AIS	Air-Insulated Switchgear
GIS	Gas-Insulated Switchgear
k	actual transformation ratio
k_r	rated transformation ratio
ε	ratio error
$\Delta\varphi$	phase displacement
S_r	rated output
U_{sys}	highest voltage for system
U_m	highest voltage for equipment
U_{Pr}	rated primary voltage
U_{Sr}	rated secondary voltage
F_V	rated voltage factor
f_R	rated frequency
F	mechanical load
F_{rel}	relative leakage rate

5 Ratings

Clause 5 of IEC 61869-1 is applicable with the following modifications:

NOTE 301 Please note that additional voltage ratings, to be considered together with Subclause 5.2: Highest voltage for equipment, are given in 5.301: Standard values of rated voltages. In future revision of IEC 61869 the layout of this clause will be rearranged.

5.3 Rated insulation levels

5.3.3.301 Power-frequency withstand voltage for the earthed terminal

The rated power-frequency short-duration withstand voltage shall be 3 kV (r.m.s.).

5.5 Rated output

5.5.301 Rated output values

The standard values of rated output at a power factor of 1, expressed in voltamperes, are:

1,0 - 2,5 - 5,0 - 10 VA (burden range I)

The standard values of rated output at a power factor of 0,8 lagging, expressed in voltamperes, are:

10 - 25 - 50 - 100 VA (burden range II)

The rated output of a three-phase transformer shall be the rated output per phase.

NOTE 301 For a given transformer, provided one of the values of rated output is standard and associated with a standard accuracy class, the declaration of other rated outputs, which may be non-standard values but associated with other standard accuracy classes, is not precluded.

5.5.302 Rated thermal limiting output

The rated thermal limiting output shall be specified in voltamperes; the standard values are:

25 - 50 - 100 VA and their decimal multiples,

related to the rated secondary voltage with unity power factor.

5.5.303 Rated output values for residual voltage windings

The rated output of windings intended to be connected in broken delta with similar windings to produce a residual voltage shall be specified in voltamperes and the value shall be chosen from the values specified in 5.5.301.

5.5.304 Rated thermal limiting output for residual voltage windings

The rated thermal limiting output of the residual voltage winding shall be specified in voltamperes; the standard values are:

25 - 50 - 100 VA and their decimal multiples,

related to the rated secondary voltage with unity power factor.

NOTE 301 Where a thermal limiting output is assigned to a residual voltage winding connected in a broken delta, it should be noted that these windings are only loaded under fault conditions and therefore for a limited duration. Deviating from the definition in 3.5.301, the rated thermal output of the residual voltage winding should be referred to a duration of 8 h.

5.6 Rated accuracy class

5.6.301 Accuracy requirements for single-phase inductive measuring voltage transformers

5.6.301.1 Accuracy class designation for measuring voltage transformers

For measuring voltage transformers, the accuracy class is designated by the highest permissible percentage voltage error at rated voltage and with rated burden, prescribed for the accuracy class concerned.

5.6.301.2 Standard accuracy classes for measuring voltage transformers

The standard accuracy classes for single-phase inductive measuring voltage transformers are:

0,1 – 0,2 – 0,5 – 1,0 – 3,0

NOTE 301 Guidance on appropriate accuracy classes will be included in a future annex.

5.6.301.3 Limits of voltage error and phase displacement for measuring voltage transformers

The voltage error and phase displacement at rated frequency shall not exceed the values given in Table 301 at any voltage between 80 % and 120 % of rated voltage and with burdens:

- any value from 0 VA to 100 % of the rated burden, at a power factor equal to 1 for burden range I.
- between 25 % and 100 % of rated burden at a power factor of 0,8 lagging for burden range II.

The errors shall be determined at the terminals of the transformer and shall include the effects of any fuses or resistors as an integral part of the transformer.

For transformers with tapings on the secondary winding, the accuracy requirements refer to the highest transformation ratio, unless otherwise specified.

Table 301 – Limits of voltage error and phase displacement for measuring voltage transformers

Class	Voltage (ratio) error ε_u ±%	Phase displacement $\Delta\phi$	
		±Minutes	±Centiradians
0,1	0,1	5	0,15
0,2	0,2	10	0,3
0,5	0,5	20	0,6
1,0	1,0	40	1,2
3,0	3,0	Not specified	Not specified

NOTE Where transformers have two separate secondary windings, allowance must be made for the mutual interdependence. It is necessary to specify an output range for each winding under test and each should meet the accuracy requirements within this range with the untested windings at any burden from zero to rated value.

If no specification of output ranges is supplied, these ranges for the winding under test shall be from 25 % to 100 % of the rated output for each winding.

If one of the windings is loaded only occasionally for short periods or only used as a residual voltage winding, its effect upon other windings may be neglected.

5.6.302 Additional requirements for single-phase inductive protective voltage transformers

5.6.302.1 Accuracy class designation for protective voltage transformers

All voltage transformers intended for protective purposes, with the exception of residual voltage windings, shall be assigned a measuring accuracy class in accordance with 5.6.301.1 and 5.6.301.2. In addition, they shall be assigned one of the accuracy classes specified in 5.6.302.2.

The accuracy class for a protective voltage transformer is designated by the highest permissible percentage voltage error prescribed for the accuracy class concerned, from 5 % of rated voltage to a voltage corresponding to the rated voltage factor (see 5.302). This expression is followed by the letter P.

5.6.302.2 Standard accuracy classes for protective voltage transformers

The standard accuracy classes for protective voltage transformers are 3P and 6P, and the same limits of voltage error and phase displacement will normally apply at both 5 % of rated voltage and at the voltage corresponding to the rated voltage factor. At 2 % of rated voltage, the error limits will be twice as high as those at 5 % of rated voltage.

5.6.302.3 Limits of voltage error and phase displacement for protective voltage transformers

The voltage error and phase displacement at rated frequency shall not exceed the values in Table 302 at 5 % of rated voltage and at rated voltage multiplied by the rated voltage factor (1,2, 1,5 or 1,9) with burdens of

- any value from 0 VA to 100 % of the rated burden, at a power factor equal to 1 for burden range I.
- between 25 % and 100 % of rated burden at a power factor of 0,8 lagging for burden range II.

At 2 % of rated voltage, the limits of voltage error and phase displacement will be twice as high as those given in Table 302.

Table 302 – Limits of voltage error and phase displacement for protective voltage transformers

Class	Voltage (ratio) error ϵ_u ±%	Phase displacement $\Delta\phi$	
		±Minutes	±Centiradians
3P	3,0	120	3,5
6P	6,0	240	7,0

NOTE When ordering transformers having two separate secondary windings, because of their interdependence, the user should specify two output ranges, one for each winding, the upper limit of each output range corresponding to a standard rated output value. Each winding should fulfill its respective accuracy requirements within its output range, whilst at the same time the other winding has an output of any value from zero up to 100 % of the upper limit of its output range. In proving compliance with this requirement, it is sufficient to test at extreme values only. If no specification of output ranges is supplied, these ranges are deemed to be from 25 % to 100 % of the rated output for each winding

5.6.302.4 Accuracy class for residual voltage windings

The accuracy class for a residual voltage winding shall be 6P or better, as defined in 5.6.302.1 and 5.6.302.2.

NOTE 301 If a residual voltage winding is used for special purposes, another standard accuracy class in accordance with 5.6.301.1, 5.6.301.2, 5.6.302.1 and 5.6.302.2 can be agreed between manufacturer and purchaser.

NOTE 302 If the residual voltage winding is used only for damping purposes, an accuracy class designation is not mandatory.

5.301 Standard values of rated voltages

5.301.1 Rated primary voltages

The standard values of rated primary voltage of three-phase transformers and of single-phase transformers for use in a single-phase system or between lines in a three-phase system shall be one of the values of rated system voltage designated as being usual values in IEC 60038. The standard values of rated primary voltage of a single-phase transformer connected between one line of a three-phase system and earth or between a system neutral point and earth shall be $1/\sqrt{3}$ times one of the values of rated system voltage.

NOTE 301 The performance of a voltage transformer as a measuring or protection transformer is based on the rated primary voltage, whereas the rated insulation level is based on one of the highest voltages for equipment of IEC 60038.

5.301.2 Rated secondary voltages

The rated secondary voltage shall be chosen according to the practice at the location where the transformer is to be used. The values given below are considered standard values for single-phase transformers in single-phase systems or connected line-to-line in three-phase systems and for three-phase transformers.

a) Based on the current practice of a group of European countries:

- 100 V and 110 V;
- 200 V for extended secondary circuits.

b) Based on the current practice in the United States and Canada:

- 120 V for distribution systems;
- 115 V for transmission systems;
- 230 V for extended secondary circuits.

For single-phase transformers intended to be used phase-to-earth in three-phase systems where the rated primary voltage is a number divided by $\sqrt{3}$, the rated secondary voltage shall be one of the fore-mentioned values divided by $\sqrt{3}$, thus retaining the value of the rated transformation ratio.

NOTE 301 The rated secondary voltage for windings intended to produce a residual secondary voltage is given in 5.301.3

5.301.3 Rated voltages for residual voltage windings

Rated secondary voltages of windings intended to be connected in broken delta with similar windings to produce a residual voltage are given in Table 303.