

INTERNATIONAL STANDARD

**Railway applications – Fixed installations – Particular requirements for AC
switchgear –
Part 3-2: Measurement, control and protection devices for specific use in AC
traction systems – Current transformers**

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INTERNATIONAL
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RAILWAY APPLICATIONS – FIXED INSTALLATIONS –
PARTICULAR REQUIREMENTS FOR AC SWITCHGEAR –****Part 3-2: Measurement, control and protection devices for
specific use in AC traction systems – Current transformers**

FOREWORD

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International Standard IEC 62505-3-2 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This second edition cancels and replaces the first edition published in 2009. This edition constitutes a technical revision.

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

- this standard was revised to reflect the latest versions of standards referenced and to remove text already included in the IEC 61869 series.
- the structure of the document was adapted to that of IEC 62505-1 and IEC 62505-2.
- ratings have been added to provide designations in line with other railway standards, for example IEC 62497.

- test requirements have been detailed to meet operating conditions of railway applications.
- partial discharge voltages have been specified in Table 2.

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

FDIS	Report on voting
9/2564/FDIS	9/2576/RVD

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

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

This standard is to be read in conjunction with IEC 61869-1:2007 and IEC 61869-2:2012 (see Introduction).

A list of all parts in the IEC 62505 series, published under the general title *Railway applications – Fixed installations – Particular requirements for AC switchgear*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

Where a particular clause/subclause of IEC 61869-2 is not mentioned in this standard, that clause/subclause applies as far as reasonable. Where requirements relate exclusively to three-phase systems or to voltages outside those in use in traction systems, they are not applicable. Where this standard states “addition” or “replacement”, the relevant text of IEC 61869-2 is to be adapted accordingly.

The numbering of clauses in the IEC 61869 series is similar to that in the IEC 62505 series.

Where terms defined in IEC 61869-1 and IEC 61869-2 conflict with definitions of the same terms as given in IEC 60050-811:2017 or of the other railway applications documents listed in the normative references, the definitions in IEC 61869-1 and IEC 61869-2 are to be used.

NOTE The suffix N which appears in this document for rated values is not present in IEC 61869-1 and IEC 61869-2.

References in subclauses of IEC 61869-1 and IEC 61869-2 have to be replaced by references to applicable subclauses in this document as far as reasonably possible.

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RAILWAY APPLICATIONS – FIXED INSTALLATIONS – PARTICULAR REQUIREMENTS FOR AC SWITCHGEAR –

Part 3-2: Measurement, control and protection devices for specific use in AC traction systems – Current transformers

1 Scope

This part of IEC 62505 is applicable to new current transformers which are:

- intended for use in indoor or outdoor fixed installations in traction systems, and
- operated with an AC line voltage and frequency as specified in IEC 60850.

NOTE 1 IEC 60850 specifies the AC traction systems:

- 15 kV 16,7 Hz,
- 12 kV 25 Hz,
- 12,5 kV, 20 kV also 25 kV with 50 Hz and
- 12,5 kV, 20 kV, 25 kV also 50 kV with 60 Hz z.

NOTE 2 As rails of AC traction systems are typically connected to earth and included in the return current path, all phase to earth voltages are subject to the limits as given in IEC 60850. Nevertheless, conductor to conductor voltages are some times higher, e.g. in autotransformer systems.

This document does not provide specific requirements for AC traction systems supplied with a frequency of 25 Hz or with a nominal voltage of 12,5 kV or 50 kV. Nevertheless requirements set out in this document can also be used as a guidance for these systems.

This document also applies to low-voltage current transformers which are operated in a traction system with an AC line voltage and frequency as specified in IEC 60850.

NOTE 3 These are e.g. current transformers without primary conductor and primary insulation of their own, e.g. of the cable or ring core type.

Current transformers are mainly used with:

- measuring instruments,
- protective devices.

This document also applies to current transformers other than inductive types as far as reasonably possible. Requirements of this document have priority.

NOTE 4 Combined current and voltage transformers are typically not used in fixed installations in traction systems.

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 60850:2014, *Railway applications – Supply voltages of traction systems*

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

IEC 61869-2:2012, *Instrument transformers – Part 2: Additional requirements for current transformers*

IEC 62236-5:2018, *Railway applications – Electromagnetic compatibility – Part 5: Emission and immunity of fixed power supply installations and apparatus*

IEC 62497-1:2010, *Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment*
IEC 62497-1:2010/AMD1:2013

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61869-1:2007, except for 3.2.1 to 3.2.9 and IEC 61869-2:2012, and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

NOTE Terms 3.2.1 to 3.2.3 of IEC 61869-1:2007 address voltage definitions which are differently defined in railway systems. Terms 3.2.4 to 3.2.9 of IEC 61869-1:2007 address aspects specific to three-phase systems.

3.1.1

nominal voltage

U_n

suitable approximate voltage value used to designate or identify a given supply system

Note 1 to entry: This value is also assigned to the current transformer to show its usability in the supply system.

Note 2 to entry: An autotransformer system which is supplied with 2 phases, having a phase shift of 180° between them, is commonly named $2 \times U_n$ according to the U_n supplied to the contact line system.

[SOURCE: IEC 62497-1:2010, 3.4.1, modified – The notes 1 and 2 to entry have been added.]

3.1.2

rated voltage

U_{Ne}

value of voltage assigned by the manufacturer to the equipment or part of it and to which operating and performance characteristics are referred

Note 1 to entry: This value is also used to determine its dielectric characteristics and will be used instead of the rated insulation voltage (U_{Nm}) as defined and used in IEC 62497 1:2010.

Note 2 to entry: The symbol U_r is not used for current transformers used in railway systems.

[SOURCE: IEC 62497-1:2010, 3.4.3, modified – Symbol added, wording of definition adapted and NOTE replaced by Note 1 to entry and Note 2 to entry.]

3.1.3

overvoltage category

OV

numeral defining a transient overvoltage condition

Note 1 to entry: This definition uses different wording as in other parts of the IEC 62505 series.

[SOURCE: IEC 60050-581:2008, 581-21-02, modified – The Note 1 to entry has been added.]

3.1.4**pollution degree****PD**

numeral characterizing the expected pollution of the micro-environment

Note 1 to entry: This definition uses different wording as in other parts of the IEC 62505 series.

[SOURCE: IEC 60050-581:2008, 581-21-07 modified – The Note 1 to entry has been added.]

3.2 Abbreviated terms

For the purposes of this document, the abbreviated terms given in IEC 61869-2:2012, 3.7 apply, but are amended by the following.

EMC	electromagnetic compatibility
OV	overvoltage category
PD	pollution degree
U_d	power-frequency withstand voltage
U_m	highest voltage for equipment
U_{max1}	highest permanent voltage
U_{max2}	highest non-permanent voltage
U_n	nominal voltage
U_{Ne}	rated voltage
U_{Nm}	rated insulation voltage

4 Service conditions

Clause 4 of IEC 61869-1:2007 is applicable with the following modifications:

- the minimum ambient air temperature under normal service conditions for indoor current transformers shall be $-5\text{ }^{\circ}\text{C}$;
- Subclause 4.4 does not apply;

NOTE 1 This subclause specifies possible scenarios of three-phase system's star-point earthing.

- for special service conditions, agreement shall be made between purchaser and supplier. IEC 62498-2 should be taken as guidance for the selection of appropriate classifications.

NOTE 2 The altitude reference condition is 1 000 m as per IEC 61869-1. The altitude reference of IEC 62497-1 (up to 2 000 m) applies to insulation coordination only and is not considered as reference condition in this document.

5 Rating**5.1 General**

Clause 5 of IEC 61869-2:2012 is applicable except as noted in 5.2 to 5.6 below:

NOTE References in this document typically name IEC 61869-2:2012 only. Nevertheless, clauses of IEC 61869-2:2012 normally reference IEC 61869-1:2007 and specify the deviations from it.

Subclauses 5.2, 5.3 and 5.4 do not apply to low-voltage current transformers. The related clauses of IEC 61869-2:2012 apply for these devices.

5.2 Nominal voltage (U_n)

The nominal voltage U_n shall be one of the AC voltages listed in Table 1 of this document or Table B.1 of IEC 60850:2014.

5.3 Rated voltage (U_{Ne})

Subclause 5.2 of IEC 61869-1:2007 is not applicable.

The rated voltage U_{Ne} shall be chosen taking into consideration the maximum voltage level suitable to be permanently applied to the current transformer (i.e. highest permanent voltage U_{max1} as defined in IEC 60850).

The value of U_{Ne} shall be used whenever IEC 61869-1 or IEC 61869-2 make reference to U_m unless another value is named explicitly.

NOTE 1 The insulation characteristics determined by applying U_{max1} are expected to be suitable to allow the highest non-permanent voltage U_{max2} taken from IEC 60850.

NOTE 2 The rated voltage for fixed installations in railway applications is a phase to earth value.

5.4 Insulation coordination

5.4.1 General

Insulation coordination shall be conducted according to IEC 62497-1, for example selection of values for over voltage category (OV) and pollution degree (PD).

The rated voltage U_{Ne} shall be used when IEC 62497-1 refers to the rated insulation voltage U_{Nm} .

The definition of the four overvoltage categories shall be as in 4.2.3.2 of IEC 62497-1:2010.

The definition of the seven pollution degrees shall be as in 4.4 and Table A.4 of IEC 62497-1:2010.

5.4.2 Rated insulation level

Subclause 5.3 of IEC 61869-1:2007 is replaced by the following:

The values of the rated impulse withstand voltage U_{Ni} and of the power-frequency withstand voltage U_d for circuits connected to the contact line shall be as given in Table 1, taken from the values listed in IEC 62497-1.

Table 1 – Nominal voltages (U_n), rated voltages (U_{Ne}), rated impulse voltages (U_{Ni}) and power-frequency withstand voltages (U_d) for circuits connected to the contact line

U_n kV	U_{Ne} kV	OV	U_{Ni} (1,2/50 μs) kV	U_d kV
IEC 60850:2014	IEC 62497-1:2010 and IEC 62497-1:2010/AMD1:2013			
15	17,25	3 ^a	95	38 ^b
		4	125	50
	17,25 ^c	3 ^a	145	70
		4	170	70 ^b
20 ^d	24 ^d	3	125	50
		4	150 ^e	50 ^e
25	27,5	3	170	70 ^b
		4	200	95
	27,5 ^c	3	200	95
		4	250	95
	30 ^d	3	170	70 ^b
		4	200	70 ^e
	30 ^{d, f}	4	325	140

NOTE The rated power-frequency withstand voltage is represented by U_d as used in IEC 62271-1 not by U_a as used in IEC 62497-1. U_a is used in IEC 62271-1 for the rated auxiliary voltage.

^a Not commonly used.

^b Values taken from Table 1 of IEC 62271-1:2017 as being well-established practice.

^c For higher requirements on insulation system.
This is common practice in some countries with larger number of installations at altitude up to 2 000 m without additionally applying an altitude correction factor.

^d Values taken from Table B.1 of IEC 60850:2014.

^e Values taken from experience and being well-established practice.

^f For higher requirements on insulation in systems with a phase shift of 180°.
An increased test voltage could be favourable for these terminals (e.g. between phases of an AT-system with $U_n = 25$ kV).

Subclauses 5.3.4 and 5.3.5 of IEC 61869-1:2007 apply.

NOTE These subclauses specify the power-frequency withstand voltage of 3 kV between-section and for secondary terminals.

5.5 Rated frequency

Subclause 5.4 of IEC 61869-1:2007 is replaced by the following:

The standard values of the rated frequency shall be 16,7 Hz, 50 Hz and 60 Hz as specified in 4.2 of IEC 60850:2014.

5.6 Rated accuracy classes

Subclause 5.6 of IEC 61869-2:2012 is applicable with the following addition:

Determination of rated accuracy classes for protection cores needs careful consideration for any special operating conditions, such as auto-reclosure scheme or permanent operation at current zero (e.g. tank protection transformers). Current transformers with an air gap in the

magnetic circuit are more robust against remanence and can therefore provide a satisfactory response.

NOTE IEC TR 61869-100 provides guidance on the selection of ratings for current transformers for protection purposes.

6 Design and construction

6.1 General

Clause 6 of IEC 61869-2:2012 is applicable except as follows below in 6.2 to 6.5.

6.2 Transformer construction

Subclauses 6.1 and 6.2 of IEC 61869-1:2007 are not applicable.

Current transformers with integrated electronic devices for example digital interfaces shall also comply with the requirements of the applicable standard of the IEC 61869 series. The requirements of this document shall have priority.

6.3 Requirements for the external insulation

Subclause 6.6 of IEC 61869-1:2007 applies to low-voltage current transformers.

For current transformers with a nominal voltage as specified in 5.2, 6.6 of IEC 61869-1:2007 is replaced by:

All creepage distances in air shall be based on the rated voltage U_{Ne} and determined according to Clause 6 of IEC 62497-1:2010.

Creepage distances other than in air are fixed by the manufacturer according to the insulation system.

Altitude correction shall be carried out as specified by 5.4 of IEC 62497-1:2010 and IEC 62497-1:2010/AMD1:2013.

6.4 Electromagnetic compatibility (EMC)

Subclause 6.11 of IEC 61869-1:2007 is applicable with the following exception:

Test values shall be taken from IEC 62236-5.

NOTE EMC tests are limited to current transformers with integrated electronic devices, e.g. digital interfaces as covered by IEC 61869-6 and IEC 61869-8 (under consideration).

6.5 Nameplates

Subclause 6.13 of IEC 61869-1:2007 is applicable with the following exception:

The symbol of the rated voltage shall be U_{Ne} as defined in this document.

7 Tests

7.1 General

Clause 7 of IEC 61869-2:2012 is applicable except as follows below in 7.2 and 7.3.

All test voltages for dielectric tests on the main circuit shall be taken from Table 1 specified for U_{Ni} respectively U_d .

7.2 Electromagnetic compatibility tests (EMC)

Subclause 7.2.5 of IEC 61869-1:2007 is applicable except as follows:

Test values shall be taken from IEC 62236-5.

7.3 Partial discharge test

Subclause 7.3.2 of IEC 61869-1:2007 is applicable except as follows:

For current transformers with a nominal voltage as specified in 5.2, Table 3 of IEC 61869-1 is replaced by Table 2 of this document.

NOTE As indicated in 5.3.3.1 of IEC 61869-1:2007, partial discharge requirements do not apply to low voltage current transformers.

Table 2 – Partial discharge test voltages and permissible levels

Test arrangement	Partial discharge test voltage (RMS)	Maximum permissible partial discharge level	
		Solid insulation	Immersed in liquid or gas
	kV	pC	pC
Phase to earth	$\sqrt{3} \times U_{Ne}$	50	10
	$1,2 \times U_{Ne}$	20	5
NOTE Values are derived from Table 3 of IEC 61869-1:2007 by replacing U_m with $\sqrt{3} \times U_{Ne}$.			

8 Rules for transport, storage, erection, operation and maintenance

Clause 8 of IEC 61869-1:2007 is applicable.

9 Safety

Clause 9 of IEC 61869-1:2007 is applicable.

10 Influence of the product on the environment

Clause 10 of IEC 61869-1:2007 is applicable.

11 Information to be given with enquiries, tenders and orders

Information to be given with enquiries, tenders and orders shall be as specified for the rating plate markings of the specific type of current transformer in 6.13.202 of IEC 61869-2:2012.