

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**Railway applications – Fixed installations – Particular requirements for a.c. switchgear –**

**Part 3-3: Measurement, control and protection devices for specific use in a.c. traction systems – Single-phase inductive voltage transformers**

**Applications ferroviaires – Installations fixes – Exigences particulières pour appareillage à courant alternatif –**

**Partie 3-3: Dispositifs de mesure, de commande et de protection pour usage spécifique dans les systèmes de traction à courant alternatif – Transformateurs inductifs de tension monophasés**



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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

**Part 3-3: Measurement, control and protection devices  
for specific use in a.c. traction systems –  
Single-phase inductive voltage transformers**

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International Standard IEC 62505-3-3 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways. This standard is based on EN 50152-3-3.

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

FDIS	Report on voting
9/1223/FDIS	9/1236/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.

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

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

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## INTRODUCTION

Part 3 of IEC 62505, "Railway applications – Fixed installations – Particular requirements for a.c. switchgear", concerning the measurement, control and protection devices for specific use in a.c. traction systems, comprises:

- IEC 62505-3-1: Application guide (informative document)
- IEC 62505-3-2: Single-phase current transformers (normative document)
- IEC 62505-3-3: Single-phase inductive voltage transformers (normative document)

This Standard applies to inductive voltage transformers used at traction voltages and frequencies according to IEC 60850.

The requirements contained in this Standard complement those given in IEC 60044-2:1997.

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

## Part 3-3: Measurement, control and protection devices for specific use in a.c. traction systems – Single-phase inductive voltage transformers

### 1 Scope

This part of IEC 62505 gives particular requirements for voltage transformers used in a.c. single-phase railway applications, fixed installations.

This International Standard applies to inductive voltage transformers used at traction voltages and frequencies according to IEC 60850.

The main uses of these voltage transformers are:

- voltage indication;
- measurement;
- protection.

### 2 Normative references

The following referenced documents are indispensable for the application 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 60044-2:1997, *Instrument transformers – Part 2: Inductive voltage transformers*

IEC 60529:2001, *Degrees of protection provided by enclosures (IP Code)*

IEC 60850, *Railway applications – Supply voltages of traction systems*

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

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

IEC 62505 (all parts), *Railway applications – Fixed installations – Particular requirements for a.c. switchgear*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62505-1, Clause 3 and in IEC 60044-2:1997, Clause 2, apply.



## 4 Service conditions

Where the equipment described in this part of the standard is mounted on circuit breakers to IEC 62505-1, then the service conditions of that standard apply. Where they are separately mounted and are used in association with switchgear then the same service conditions as the switchgear apply.

## 5 Characteristics and use

The voltage transformer shall be:

- a) either mounted inside the circuit breaker specified in IEC 62505-1; technical requirements of this IEC 62505-3-3 apply together with the construction and test requirements (as applicable) of IEC 62505-1;
- b) or separately mounted, free standing; technical requirements of this IEC 62505-3-3 apply.

## 6 Rating and design requirements

Clauses 5 and 6 of IEC 60044-2:1997 apply with the following exceptions:

- In subclause 5.1.2 the following shall be added at the end of the subclause:  
The secondary voltage values of 100 V or 110 V shall be preferred.  
The rated ratio is given by the primary nominal voltage, as defined in IEC 60850, divided by the rated secondary voltage.
- In Clause 6 the entire subclause 6.1.1 shall be replaced by:  
**6.1.1 Rated insulation levels for the primary winding**  
Voltage transformers covered by this standard shall have the same insulation ratings and test values as the equipment into which they are installed. See Table 1 of IEC 62505-1 and IEC 62505-2. Free standing voltage transformers shall meet the same requirements.
- Subclause 6.1.5 of IEC 60044-2 is valid unless inconsistent with 9.1 of this International Standard.

## 7 Withstand conditions

The following requirements, additional to those of IEC 60044-2:1997, apply:

### 7.1 Primary side

The voltage transformer shall withstand the overvoltage characteristics described in IEC 60850, Annex A.

NOTE These events occur often and special attention should be paid to protect these voltage transformers.

### 7.2 Secondary side

The voltage transformer shall withstand the current produced in secondary winding for 1 s, when its terminals are short circuited. The primary voltage shall be  $U_{\max 2}$  for this condition. Where no  $U_{\max 2}$  value is specified,  $U_{\max 1}$  shall be used.

NOTE A rapid fuse or a miniature circuit breaker may be inserted at the load. On request, a slow-blow low-voltage fuse should be inserted between secondary winding and secondary terminals.

## 8 Ferro-resonance

### 8.1 General

The following requirements, additional to those of IEC 60044-2:1997, apply:

The structure of railway electrification network may easily generate ferro-resonance phenomena. They occur mainly in 25 kV, 50 Hz systems.

When specified by the purchaser, the voltage transformer connected directly to the overhead line shall have the following characteristics in order to avoid the generation of ferro-resonance phenomena and withstand the overvoltages caused by the same.

### 8.2 Prevention of the generation

The following features shall be adopted:

- minimum resistance of the primary winding: shall be specified by the purchaser;

NOTE Typical resistance values are between 15 k $\Omega$  and 50 k $\Omega$ .

- flux density such that at  $U_{\max 2}$  (see IEC 60850) the saturation point is not reached.

### 8.3 Prevention of damages in the voltage transformer

The following features shall be adopted:

- ability to withstand without damage on the primary side a voltage wave obtained by summing a sinusoidal wave at rated frequency with a square wave at 1/3 of the rated frequency, with a total peak value of approximately  $1,6 \times U_n$ ;
- suitability to operate continuously at 1/3 of the rated frequency and rated voltage;
- voltage factor of 1,9 ( $1,9 \times U_n$  for 8 h at rated frequency).

### 8.4 Ferro-resonance withstand test

The voltage transformer will be considered suitable to withstand ferro-resonance if these characteristics are checked and tested, as a special type test named ferro-resonance withstand test. This consists of a temperature-rise test at rated voltage, rated burden and 1/3 of rated frequency. The standard temperature rises shall not be exceeded.

## 9 Particular design and construction characteristics

The following requirements, additional to those of IEC 60044-2:1997, apply:

### 9.1 Pollution

The dust pollution on railway tracks (e.g. in tunnels and at the seaside) is often higher than on high voltage transmission lines. For this reason the creepage distance shall not be less than indicated in IEC 62497-1, Table A.7, for the appropriate pollution degree.

NOTE For the choice of the appropriate pollution degree, the degrees used in the associated switchgear (see IEC 62505-1 and IEC 62505-2) should be taken into account.

### 9.2 External flashover test

When specified by the purchaser, outdoor units shall be able to withstand an external flashover of the primary bushing and be capable of continued service. This will be tested as a special type test named the external flashover test by repeating dielectric, partial discharge and accuracy tests after a flashover. The flashover is made by creating a permanent

conduction on the creepage distance of the insulator. The voltage applied shall be  $U_{\max 1}$  the resulting fault current being maintained for 100 ms up to the following values:

- for 15 kV systems            50 kA r.m.s.;
- for 25 kV systems            16 kA r.m.s.

### 9.3 Floating potentials and earthing

No metallic part of the voltage transformer shall be left at floating potential. The earthing connection shall be able to carry the rated short time withstand current for a duration of 1 s.

### 9.4 Electromagnetic compatibility

The voltage transformer shall comply with IEC 62236-5 for electromagnetic compatibility.

### 9.5 Secondary connection box

The secondary connection box of outdoor voltage transformers shall have a minimum protection degree IP 54 in accordance with IEC 60529.

### 9.6 Information to be given by the purchaser

The purchaser shall provide the following information:

- location of the voltage transformer (e.g. on a pole or mast, in a cabinet, on the floor indoor or outdoor);
- type of primary connection;
- special material and form for connections, if necessary;
- rated voltage of the primary side;
- rated voltage of the secondary side;
- rated value of the output;
- accuracy class of the voltage transformer;
- ferro-resonance requirements, if any;
- indication of the insulation level ( $U_{Nm}$ ,  $U_{Ni}$ ,  $U_a$  - see IEC 62497-1).

### 9.7 Information to be given by the supplier

The supplier shall provide the following information:

- variation of the actual transformation ratio of the voltage transformer in function of the frequency in the range from rated frequency to 1 kHz (if required);
- weight;
- dimensions;
- characteristics of the internal protection (see note of 7.2), if applicable.

## 10 Tests – General

Clause 7 of IEC 60044-2:1997 applies with the following addition:

Add in subclause 7.3 (Special tests) the following two points:

- d) ferro-resonance withstand test (see 8.1),
- e) external flashover test (see 9.2).