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INTERNATIONAL STANDARD

Railway applications – Fixed installations – Particular requirements for AC switchgear –
Part 3-1: Measurement, control and protection devices for specific use in AC traction systems – Devices

IEC 62505-3-1:2020-03(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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CONTENTS

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

Part 3-1: Measurement, control and protection devices for specific use in AC traction systems – Devices

FOREWORD

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International Standard IEC 62505-3-1 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:

– distinguish between requirements, Clauses 4 and 5, and application guides, annexes;
– include requirements on devices for example control and protection relays not included before;
– remove parts already included in other standards, for example EN 50633 for protection principles, which is intended to become an IEC standard.

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

FDIS	Report on voting
9/2563/FDIS	9/2575/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.

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- withdrawn,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

IEC 62505-3-1 is intended for measurement, control and protection devices for specific use in AC traction systems other than current and voltage transformers. These are covered by IEC 62505-3-2 and IEC 62505-3-3 respectively.

This standard covers a large variety of different kinds of equipment used in railway fixed installations which do not have railway specific product standards. It provides clarification on how to select ratings and test values relevant for operation in fixed installations. This standard should be read in conjunction with the relevant product standard of the equipment concerned.

Annex A and Annex B are application guides. Annex A deals with railway specific measurement principles and Annex B provides guidance on the design of control systems for AC traction. These application guides identify characteristics of and parameters for procedures and functions used. Guidance on protection principles is given in EN 50633.

The clause numbering of this part is different to that used in all other parts of the IEC 62505 series. Clause numbering in the other parts is the same as in the specific referenced product standard.

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

Part 3-1: Measurement, control and protection devices for specific use in AC traction systems – Devices

1 Scope

This part of IEC 62505 is applicable to new low voltage devices for measurement, control and protection which are:

– for indoor or outdoor fixed installations in traction systems, and

– operated in conjunction with high voltage equipment 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.

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 measurement, control and protective devices other than low voltage devices and not covered by a specific railway product standard as far as reasonably possible. Requirements of this document prevail.

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 60255-1, *Measuring relays and protection equipment – Part 1: Common requirements*

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

IEC 61243-5, *Live working – Voltage detectors – Part 5: Voltage detecting systems (VDS)*

IEC 61869 (all parts), *Instrument transformers*

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

IEC 62236-5:2018, *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 AC switchgear*

IEC 62505-2:2016, *Railway applications – Fixed installations – Particular requirements for AC switchgear – Part 2: Disconnectors, earthing switches and switches with nominal voltage above 1 kV*

IEC 62505-3-3:—[1], *Railway applications – Fixed installations – Particular requirements for AC switchgear – Part 3-3: Measurement, control and protection devices for specific use in AC traction systems – Voltage transformers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62505 (all parts) 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

3.1
under-voltage
voltage the value of which is lower than a specified limiting value

[SOURCE: IEC 60050-151:2001, 151-15-29]

3.2
under-voltage off
control function which permits a mechanical switching device to open, with or without time-delay, when the voltage of the circuit, the mechanical switching device is connected to, falls below a predetermined value

Note 1 to entry: This term is used when a loss of primary voltage is considered.

Note 2 to entry: This function will in most cases require some kind of shunt release.

3.3
under-voltage release
shunt release which permits a mechanical switching device to open or close, with or without time-delay, when the voltage across the terminals of the release falls below a predetermined value

Note 1 to entry: This term is used when a loss of an auxiliary voltage is considered.

[SOURCE: IEC 60050-441:2000, 441-16-42, modified – Note 1 to entry has been added.]

3.4
under-voltage trip
protection function which permits a mechanical switching device to open, with or without time-delay, when the voltage of the circuit, the mechanical switching device is connected to, falls below a predetermined value

Note 1 to entry: This term is used when a loss of primary voltage is considered.

Note 2 to entry: This function will in most cases require some kind of shunt release.

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[1] Second edition under preparation. Stage at the time of publication IEC CFDIS 62505-3-3:2019.

4 Specific requirements from the traction system

Traction systems due to for example their load, voltage and earthing conditions require thorough analysis when defining operational principles and requirements for equipment.

The design of measurement, control and protection circuits, their devices and algorithms shall consider any effect arising from:

– fast fluctuation of traction power demand;
– moving tractions units, providing scenarios with traction currents higher than failure currents;
– the return current system, especially the track, which typically is effectively connected to earth;
– fast fluctuation of operating voltages between U_{min2} and U_{max2}, with U_{min2} and U_{max2} as specified in IEC 60850;
– high number of switching operations for example caused by a high number of short circuits in the contact line systems;
– in 16,7 Hz traction systems the duration of a period of 60 ms in respect to magnetization, saturation and switching times;
– in auto-transformer systems, a phase shift of 180° resulting in an maximum operating voltage of 2 × U_{max2} but only between phases.

NOTE 1 Typically the return circuit in AC traction systems is effectively earthed. Unlike utility networks a displacement of the star point during earth faults resulting in an increase of phase voltages by factor √3 cannot happen.

NOTE 2 Equipment in a 25 kV traction system is subject to a maximum permanent operating voltage phase to earth of 27,5 kV = U_{max1}. Equipment in a 3 phase utility network with a highest system voltage U_m = 36 kV has an average continuous voltage phase to earth during 99 % of its life of 33/√3 kV = 19,1 kV.

If the above values are compared, it becomes clear that the dielectric stress of equipment in traction power supply is significantly higher and therefore the test voltages e.g. during partial discharge testing have assigned higher values in this document.

5 Requirements on measurement, control and protection devices

5.1 General

Measurement, control and protection devices shall be designed, manufactured and tested to their specific product standards. Requirements of railway standards prevail and shall be applied as far as reasonably possible. This especially concerns IEC 62497-1 for insulation coordination and IEC 62236-5 for electromagnetic compatibility.

Annex A and Annex B provide guidance on specific measurement and control principles for AC traction systems. They identify characteristics of and parameters for procedures and functions used.

5.2 Voltage detection systems

Capacitive voltage detection systems shall comply with IEC 61243-5 except for the following requirements:

– voltage absence indication shall be below 50 % of U_{min2},
– voltage presence indication shall be above 90 % of U_{min2} and
– the capacitive voltage detection system shall properly work also up to U_{max2}.

NOTE 1 The thresholds for voltage absence and presence indication are adapted considering the fact that voltages are between contact line and running rail on ground potential and also considering the tolerances of supply voltages of traction systems.

When selecting voltage detectors manufactured according to IEC 61243-1 it may be preferential to use thresholds for voltage absence and presence indication as specified before.

NOTE 2 This portable equipment is only temporarily connected to a supply voltage of the traction system.

NOTE 3 There are national standards available in some countries specifying thresholds for voltage absence and presence indication.

5.3 Devices at supply voltage of a traction system

Devices not covered by a railway specific product standard and being connected to a circuit at supply voltage of a traction system shall comply with the test voltages including partial discharge level as specified in IEC 62505-3-3 for this supply voltage. If these devices are connected to provide isolation of feeding systems the test voltages shall be taken for “across the isolating distance” from IEC 62505-2:2016, Table 1, for example when connected parallel to a disconnector.

Other requirements of IEC 62505-3-2 or IEC 62505-3-3 or for sensors as given in IEC 61869 (all parts) shall apply as far as reasonably possible and shall be agreed upon between supplier and infrastructure manager.

Devices containing electronic parts shall be subject to a function test in the intended operational circuit and under worst case conditions, for example in its installation position next to a circuit breaker during a short circuit breaking test.

Dielectric type tests shall be applied as specified in IEC 61869-1:2007, 7.2.3 with test values as specified in IEC 62505-3-3:—, 7.1. Dielectric routine tests shall be applied as specified in IEC 61869-1:2007, 7.3.1 to 7.3.4 with test values as specified in IEC 62505-3-3:—, 7.1 and 7.3. Other tests and their test requirements shall be agreed upon between purchaser and supplier prior to the order.

5.4 Protection devices

Protection devices used in railway applications shall comply with the relevant product standards, particularly IEC 60255-1. They shall also comply with the electromagnetic compatibility requirements given in IEC 62236-5.

Any protection device shall be specified based on a consideration of the specific requirements from the traction system as given in Clause 4.

Protection devices for contact line protection shall include the following protection functions:

– distance protection with a minimum of two stages and the possibility to use directional settings;
– di/dt or du/dt protection, when specified, for example by the system designer or infrastructure manager;
– de-icing protection, when specified, for example by the system designer or infrastructure manager.

They shall also include the possibility of blocking or delaying between the functions. In particular, when specified, protection functions shall be blocked for a short time when a high 2^{nd} harmonic content is detected, for example to avoid unintended tripping due to transformers inrush currents.

NOTE 1 This kind of protection device will typically use specially adapted algorithms and will therefore be different to devices intended for utility use.

NOTE 2 EN 50633 provides an application guide on protections systems including back scenarios.