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Railway applications - Fixed installations - D.C. switchgear -- Part 1: General

Bahnanwendungen - Ortsfeste Anlagen - Gleichstrom-Schalteinrichtungen -- Teil 1: Allgemeines

Applications ferroviaires - Installations fixes - Appareillage à courant continu -- Partie 1: Généralités

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Railway applications –
Fixed installations – D.C. switchgear
Part 1: General

Applications ferroviaires –
Installations fixes –
Appareillage à courant continu
Partie 1: Généralités

Bahnanwendungen –
Ortsfeste Anlagen –
Gleichstrom-Schalteinrichtungen
Teil 1: Allgemeines

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

This European Standard was prepared by SC 9XC, Electric supply and earthing systems for public transport equipment and ancillary apparatus (fixed installations), of the Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50123-1 on 2002-09-01.

This European Standard supersedes EN 50123-1:1995. It has been prepared taking into account IEC document 9/578/FDIS (61992-1) in order to align technically as much as possible this EN 50123-1 and IEC 61992-1. These documents are to be considered as technically equivalent except for those references and peculiarities which are due to the European standardisation in the railway application field.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2003-09-01

- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2005-09-01

Annexes designated “normative” are part of the body of the standard.
Annexes designated “informative” are given for information only.
In this standard, Annexes A, B and C are normative and Annexes D and E are informative.

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1 Scope

The EN 50123 series specifies requirements for d.c. switchgear and controlgear and is intended to be used in fixed electrical installations with nominal voltage not exceeding 3 000 V d.c., which supply electrical power to vehicles for public guided transport, i.e. railway vehicles, tramway vehicles, underground vehicles and trolley-buses.

Part 1 specifies general requirements.

The other parts are covering

Part 2 D.C. circuit breakers,

Part 3 Indoor d.c. disconnectors, switch-disconnectors and earthing switches,

Part 4 Outdoor d.c. disconnectors, switch-disconnectors and earthing switches,

Part 5 Surge arresters and low voltage limiters for specific use in d.c. systems,

Part 6 D.C. switchgear assemblies,

Part 7-1 Measurement, control and protection devices for specific use in d.c. traction systems – Application guide,

Part 7-2 Measurement, control and protection devices for specific use in d.c. traction systems – Isolating current transducers and other current measuring devices,

Part 7-3 Measurement, control and protection devices for specific use in d.c. traction systems – Isolating voltage transducers and other voltage measuring devices

2 Normative references

This European Standard series incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard series only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 50119	2001	*Railway applications – Fixed installations – Electric traction overhead contact lines*
EN 50121	Series	*Railway applications – Electromagnetic compatibility*
EN 50122-1	1997	*Railway applications – Fixed installations – Part 1: Protective provisions relating to electrical safety and earthing*
EN 50124-1	2001	*Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for electrical and electronic equipment*
EN 50125-2	2002	Railway applications – Environmental conditions for equipment – Part 2: Fixed *electrical installations*
EN 50126	1999	*Railway applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)*
EN 50163	1995	*Railway applications – Supply voltage of traction systems* (IEC 60850:2000)
EN 60099-1	1994	*Surge arresters – Part 1: Non-linear resistor type gapped surge arresters for a.c. systems* (IEC 60099-1:1991)

EN 60099-4	1993	*Surge arresters – Part 4: Metal-oxide surge arresters without gaps for a.c. systems* (IEC 60099-4:1991)
EN 60129 + A1 + A2	1994 1994 1996	*Alternating current disconnectors and earthing switches* (IEC 60129:1984 + A1:1992 + A2:1996)
EN 60243-1	1998	*Electrical strength of insulating materials – Test methods – Part 1: Tests at power frequencies* (IEC 60243-1:1998)
EN 60269	series	*Low-voltage fuses* (IEC 60269 series)
EN 60298	1996	*AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV* (IEC 60298:1990 + corr. April 1995 + A1:1994)
EN 60507	1993	*Artificial pollution tests on high-voltage insulators to be used on a.c. systems* (IEC 60507:1991)
EN 60529	1991	*Degrees of protection provided by enclosures (IP Code)* (IEC 60529:1989)
EN 60694	1996	*Common specifcations for high-voltage switchgear and controlgear standards* (IEC 60694:1996)
EN 60721	series	*Classification of environmental conditions* (IEC 60721 series)
EN 60947-1	1999	*Low-voltage switchgear and controlgear – Part 1: General rules* (IEC 60947-1:1999, mod.)
EN 60947-2 + A1	1996 1997	*Low-voltage switchgear and controlgear – Part 2: Circuit breakers* (IEC 60947-2:1995 + A1:1997)
HD 214 S2	1980	*Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions* (IEC 60112:1979)
HD 380 S2	1987	*Test methods for evaluating resistance to tracking and erosion of electrical insulating materials used under severe ambient conditions* (IEC 60587:1984)
HD 588.1 S1	1991	*High-voltage test techniques – Part 1: General definitions and test requirements* (IEC 60060-1:1989 + corr. March 1990)
IEC 60050-441	1984	*International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses*
IEC 60050-446	1983	*International Electrotechnical Vocabulary (IEV) – Chapter 446: Electrical relays*
IEC 60050-605	1983	*International Electrotechnical Vocabulary (IEV) – Chapter 605: Generation, transmission and distribution of electricity – Substations*
IEC 60050-811	1991	*International Electrotechnical Vocabulary (IEV) – Chapter 811: Electric traction*
IEC 60466	1987	*A.C. insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 38 kV*
IEC 61245	1993	*Artificial pollution tests on high voltage insulators to be used in d.c. systems*

3 Definitions

For the purpose of this European Standard series, the definitions given in IEC 60050-441, IEC 60050-446, IEC 60050-605, IEC 60050-811, EN 50124-1, EN 60099-1, EN 60099-4, EN 60298 and EN 60947 apply together with the following:

3.1 General terms

3.1.1
switchgear
general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment; it covers also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures

NOTE For the sake of simplicity in this standard the term “switchgear” means “switchgear and controlgear”.

3.1.1.1
d.c. switchgear and controlgear assembly
combination of one or more d.c. switching devices together with associated control, measuring, signalling, protective, regulating equipment, etc., completely assembled under the responsibility of the supplier, with all the internal electrical and mechanical interconnections and structural parts

NOTE 1 Throughout the Standard, the abbreviation switchgear assembly is used for a d.c. switchgear and controlgear assembly.

NOTE 2 The components of the switchgear assembly may be electromechanical or electronic.

NOTE 3 An enclosure, but not an integral enclosure, when housing a switching device and some associated controlgear, may be considered as a switchgear assembly.

3.1.2
switching device
device designed to make or break the current in one or more electric circuits
[IEV 441-14-01]

3.1.3
d.c. circuit breaker
switching device capable of making, carrying and breaking direct currents under normal circuit conditions and also making, carrying (up to a specified limit and for a specified time) and breaking currents under specified abnormal conditions, such as those of short-circuit

3.1.4
d.c. disconnector
mechanical switching device, which provides, in the open position, for safety reasons, an isolating distance in accordance with specified requirements

NOTE 1 The disconnector is capable of opening and closing a circuit when either negligible d.c. current is broken or made, or when no significant change in the voltage across the terminals of the disconnector occurs. It is also capable of carrying d.c. currents under normal circuit conditions and carrying, for a specified time, currents under abnormal conditions such as those of short-circuit.

NOTE 2 A disconnector is not suitable for making or breaking load current, fault current or other current arising from the effects of lightning or transient phenomena.

NOTE 3 A disconnector is only able to make or break current of very limited magnitude such as those arising from electrostatic charging or discharges across undamaged insulation. The ability to make or break minimum currents due to eventual marginal transient conditions of the network is subject to agreement between purchaser and supplier.

3.1.5
switch-disconnector
mechanical switching device capable of making, carrying and breaking currents in normal circuit conditions and, when specified, in given operating overload conditions. In addition, it is able to carry, for a specified time, currents under specified abnormal circuit conditions, such as short-circuit conditions. Moreover, it complies with the requirements for a disconnector (see 3.1.4)

When specified, a switch-disconnector may be designed for making short-circuit currents, but not for breaking the same.

NOTE Outdoor switch-disconnectors, in given special conditions, may be required to be suitable for breaking overload currents of specified amplitude.

3.1.6
earthing switch
mechanical switching device for earthing parts of the circuit, capable of withstanding for a specified time, currents under abnormal conditions such as those of short-circuit, but not required to carry currents under normal conditions of the circuit

NOTE An earthing switch may have a short-circuit making capacity (see 3.2.23).

[IEV 441-14-11]

3.1.7
low-voltage limiter
device intended to be in parallel in those parts of a traction system where overvoltages are expected having the function of limiting the voltage to predetermined values

3.1.8
d.c. sensor
device used for detecting a current or a voltage in d.c. main circuit, which produces an output signal, proportional to and linear (over a range) with the primary input, for connection to a secondary device which acts on the signal

3.1.9
d.c. shunt
device connected in the primary circuit, usually composed of metal grids, that provides a millivolt output proportional to the current following in the primary circuit

3.1.10
isolating transducer

device which is interposed between the output of a sensor in the main circuit and the input of a secondary device used for measurement or protection, and used to provide an output isolated from the main circuit and, usually, at lower voltage

3.1.11
hall effect sensor
type of sensor which fits around the main circuit current carrying conductor and uses a single or multiple Hall effect cells situated in the magnetic field of an iron circuit and which is energised by the current in the main conductor

3.1.12
divider
bank of resistors connected across the main supply with a footing resistor used as the output, which gives a voltage proportional to the main supply. This output is connected either directly or indirectly through an isolation transducer to the voltage terminals of the secondary device

3.1.13
operation
motion of the moving contact(s) from one position to another position, for example open to close or open to earth

NOTE 1 This may be a closing operation or an opening operation.

NOTE 2 If a distinction is necessary, the terms "electrical operation" (for example make and break) and "mechanical operation" (for example closing and opening) should be used.

NOTE 3 The position of a switching device where the continuity of the main circuit is assured is indicated as "close" position.

NOTE 4 The position of a switching device where the prescribed distance between the contacts of the switching device is assured is indicated as "open" position.

3.1.14
operating cycle (of a mechanical switching device)
succession of operations from one position to another and back to the first position through all other positions, if any [IEV 441-16-02]

3.1.15
dependent manual operation (of a mechanical switching device)
operation solely by means of directly applied manual energy, such that the speed and force of the operation are dependent upon the action of the operator [IEV 441-16-13]

3.1.16
stored energy operation (of a mechanical switching device)
operation by means of energy stored in the device itself prior to the completion of the operation and sufficient to complete it under predetermined conditions

NOTE This kind of operation may be subdivided according to
a) the energy storage mode (spring, weight, etc.);
b) the origin of energy (manual, electric, etc.);
c) the energy releasing mode (manual, electric, etc.).

[IEV 441-16-15]

3.1.17
independent manual operation (of a mechanical switching device)
stored-energy operation where the energy originates from manual power, stored and released in one continuous operation, in such a way that the speed and force of the operation are independent from the action of the operator [IEV 441-16-16]

3.1.18
independent power operation
operation by means of energy where the energy originates from an external power source and is released in a single continuous operation, in such a way that the speed and force of the operation are independent from the action of the operator

3.1.19
switching device with interlock preventing opening and/or closing operations
switching device in which an operation (closing and/or opening) is prevented by interlocking means reflecting given system conditions

3.1.20
utilisation category (of a switching device)
combination of specified requirements related to the condition in which the switching device fulfils its purpose, selected to represent a characteristic group of practical applications [IEV 441-17-19]

NOTE The specified requirements may concern, for example the values of the making capacities, if applicable, breaking capacities and other characteristics, the associated circuits and the relevant conditions of use and behaviour. The term "duty" used elsewhere in the standard corresponds to a particular aspect of the utilisation category.

3.1.21
unidirectional switching device
switching device (for example a circuit breaker), the purpose of which is to interrupt d.c. current which is flowing in a prescribed direction through that device, and which is identified accordingly

3.1.22
bidirectional switching device
switching device (for example a circuit breaker), the purpose of which is to interrupt d.c. current which flows in either direction through that device, and which is identified accordingly

NOTE Proof of bidirectional ability is included in the interrupting type tests.

3.2 Performance characteristics

3.2.1 Voltages

3.2.1.1
nominal voltage (U_n)
voltage by which an installation or part of an installation is designated

3.2.1.2 Limits of system voltages

3.2.1.2.1
highest system voltage (U_{max})
highest value given for the voltage in the continuous operating conditions U_{max1} specified in EN 50163

3.2.1.2.2
lowest system voltage (U_{min})
lowest value given for the voltage in the continuous operating conditions U_{min1} specified in EN 50163

3.2.2
rated insulation voltage (U_{Nm})
maximum value of the d.c. voltage for which the equipment is designed in respect to its insulation

3.2.3
rated voltage (U_{Ne})
voltage value, given by the manufacturer, which, combined with rated service current, determines the utilisation of the equipment and to which the corresponding tests and utilisation categories, if any, relate

NOTE The rated voltage may differ from the nominal voltage by a quantity within permitted tolerances.

3.2.3.1
rated auxiliary and control supply voltage
voltage measured at the circuit terminals of the apparatus during its operation, including, if necessary, the auxiliary resistors or accessories supplied or required by the manufacturer to be installed in series with it, but not including the conductors to the electrical supply

3.2.3.2
rated voltage of a gapped arrester (U_r)
maximum d.c. voltage value between terminals at which the surge arrester is designated to withstand continuously

3.2.3.3
rated voltage of a gapless arrester (U_r)
the maximum d.c. voltage value between terminals at which the surge arrester is designated to operate correctly under temporary overvoltage conditions as established in the operating duty tests (see 4.7.5 of EN 50123-5). The rated voltage is used as a reference parameter for the specification of the operating characteristics

3.2.3.4
rated voltage of a low-voltage limiter (U_r)
the maximum d.c. voltage value between terminals which the low-voltage limiter is designed to withstand continuously

3.2.3.5
maximum continuous operating voltage of a gapless arrester (U_c)
voltage which corresponds to U_{max} defined in 3.2.1.2.1

3.2.3.6
protective voltage level of a gapped arrester (U_p)
crest value, declared by the supplier, higher than the maximum of the three voltage values between the surge arrester terminals: residual voltage at I_n, maximum standard lightning impulse sparkover voltage, maximum front of wave impulse sparkover voltage, the latter divided by 1,15

3.2.3.7
protective voltage level for gapless arrester (U_p)
impulse protection level of the arrester covering the maximum residual voltage for the nominal discharge current I_n

3.2.3.8
maximum withstand voltage of a low-voltage limiter (U_w)
maximum peak voltage value between terminals at which the current in the voltage limiter is zero or limited to specified values (leakage current)

3.2.3.9
maximum sparkover voltage of a low-voltage limiter (U_s)
maximum voltage value between terminals at which a gapped voltage limiter is designated to make a connection between terminals such as to limit the difference of potential between the same to a safe value

3.2.3.10
rated supply voltage in a switchgear
voltage measured at the circuit terminals of the apparatus itself during its operation, including, if necessary, the auxiliary resistors or accessories supplied or required by the manufacturer to be installed in series with it, but not including the conductors from the connection to the electrical supply

3.2.4
rated impulse withstand voltage (U_{Ni})
the peak value of an impulse voltage of prescribed form and polarity which the equipment is capable of withstanding to, without failure, under the specified test conditions

3.2.5
power-frequency voltage withstand level (dry and wet) (U_a)
power-frequency test voltage level which, when withstood by the equipment, proves the integrity of its insulation in operating conditions

3.2.6
Transient voltages

3.2.6.1
recovery voltage
voltage which appears across the terminals of a switching device after the breaking of the current [IEV 441-17-25]

3.2.6.2
maximum arc voltage ($\hat{U}_{arc}$)
maximum voltage appearing across the switching device during arcing

3.2.7
prospective current
current that would flow in the circuit if the device was replaced by a conductor of negligible impedance [IEV 441-17-01]

NOTE The prospective current may be qualified in the same way as a real current: prospective broken current, peak value of the prospective current, etc.

3.2.8
conventional free-air thermal current (I_{th})
current which may be used for the temperature-rise test of an equipment in free-air (see notes 1 and 2). This value is equal to or greater than the maximum value of the rated service current I_{Ne} of the equipment

NOTE 1 Free-air is the indoor air existing in normal conditions, reasonably free from dust and external radiations.

NOTE 2 A free-air device is a device supplied by the manufacturer without an enclosure (see 3.3.16) or a device supplied by the manufacturer with an integral enclosure (see 3.3.17).

3.2.9
conventional enclosed thermal current (I_{the})
current stated by the manufacturer which may be used for the temperature-rise tests of the equipment when mounted in a specified enclosure
This value is equal to or greater than the maximum value of the rated service current I_{Ne} of the enclosed equipment

3.2.10
rated service current (I_{Ne})
value of current stated by the manufacturer taking into account the rated voltage (see 3.2.3), the continuous duty and the utilisation category (see 3.1.20) and the protective enclosure type, if any

NOTE 1 Any current, exceeding I_{Ne} is an overload condition.

NOTE 2 If a load cycle is specified by the purchaser, it should define the steady-state currents before and after the load cycle. If the temperature-rises resulting from the load cycle exceed the temperature-rise limits, then a higher rated service current needs to be used.

3.2.10.1
nominal discharge current of a gapped arrester (I_n)
peak value of discharge current, having an 8/20 waveshape, which is used to classify an arrester. It is also the discharge current which is used to initiate follow-through current in the operating duty test

3.2.10.2
nominal discharge current of a gapless arrester (I_n)
peak value of lightning current impulse (see EN 60099-4) which is used to classify an arrester

3.2.10.3
long term withstand current of a low-voltage limiter (I_w)
current that a low-voltage limiter is able to withstand for 1 800 s in specified conditions

3.2.10.4
leakage current of a low-voltage limiter
current which flows between terminals of a low-voltage limiter when U is applied under nominal service conditions

3.2.11
rated short-time withstand current (I_{Ncw})
current that a circuit or a switching device in the closed position can carry, during a specified short time under prescribed conditions of use and behaviour