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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Railway applications – Fixed installations – DC switchgear – Part 2: DC circuit-breakers

Applications ferroviaires – Installations fixes – Appareillage à courant continu – Partie 2: Disjoncteurs en courant continu

IEC 61992-2:2006-02+AMD1:2014-04 CSV(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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RAILWAY APPLICATIONS – FIXED INSTALLATIONS – DC SWITCHGEAR –

Part 2: DC circuit-breakers

FOREWORD

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IEC 61992-2 edition 2.1 contains the second edition (2006-02) [documents 9/887/FDIS and 9/909/RVD] and its amendment 1 (2014-04) [documents 9/1791/CDV and 9/1851/RVC].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 61992-2 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

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

– all requirements applying to more than one part of the IEC 61992 series are now specified in Part 1 and consequently the related clauses in this part of the series now make reference to Part 1;
– specification of the characteristics of the circuit-breaker has been improved.

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

IEC 61992 consists of the following parts, under the general title *Railway applications – Fixed installations – DC switchgear:*

Part 1: General
Part 2: DC 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: DC 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

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- replaced by a revised edition, or
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RAILWAY APPLICATIONS – FIXED INSTALLATIONS – DC SWITCHGEAR –

Part 2: DC circuit-breakers

1 Scope

This part of IEC 61992 specifies requirements for d.c. circuit-breakers for use in fixed installations of traction systems.

NOTE Switchgear assemblies, electromagnetic compatibility (EMC) and dependability are not covered in this standard, but by other parts of this standard or by other standards, as indicated in IEC 61992-1.

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 60850:2000, *Railway applications – Supply voltage of traction systems*

IEC 61992-1:2006+ A1:2014, *Railway applications – Fixed installations – DC switchgear – Part 1: General*

IEC 61992-6:2006, *Railway applications – Fixed installations – DC switchgear – Part 6: DC switchgear assemblies*

EN 50124-1:2001, *Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for electrical and electronic equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61992-1 apply.

4 Service requirements

Environmental conditions applicable to the equipment discussed in this standard are covered in 4.1 of IEC 61992-1.

5 Characteristics of the circuit-breaker

5.1 Enumeration of the characteristics

The characteristics of a circuit-breaker and its assigned designations and values (where applicable) are covered below as follows:

– type of circuit-breaker (5.2);
– rated values and limit values of the main circuit and short-circuit characteristics (5.3);
– control circuits (5.4);
– auxiliary circuits (5.5);

– releases (5.6);
– arc voltages (5.7).

5.2 Type of circuit-breaker

A circuit-breaker is defined by the following details, as applicable.

NOTE 1 As far as applicable, the following requirements also apply to single-pole circuit-breakers electrically or mechanically interlocked in multiple systems.

a) Interruption:
   - in air;
   - via a semiconductor;
   - in vacuum bulb.

   NOTE 2 In this standard, only interruption in air or via a semiconductor is addressed. This standard may be used for other specified interrupting media, as far as applicable, where clearly specified by mutual agreement between purchaser and supplier.

b) Breaking characteristics (class designation):

   1) circuit-breakers without intended limitation of current rise during maximum fault test

      – high speed current limiting circuit-breaker H;

      the H circuit-breaker has an opening time not greater than 5 ms and a total break time not greater than 20 ms, when the current to be interrupted has a prospective sustained value of at least 7 times the circuit-breaker setting and

      $$\left[\frac{di}{dt}\right]_{t=0} \geq 5 \text{ kA/ms}$$

      – very-high speed current limiting circuit-breaker V;

      the V circuit-breaker ~~in which the opening time is~~ has a total break time not greater than 2 ms, irrespective of the other parameters of the circuit;

      – semi-high speed circuit-breaker S;

      the S circuit-breaker has an opening time not greater than 15 ms and a total break time not greater than 30 ms, when the current to be interrupted has a prospective sustained value of at least 3,5 times the circuit-breaker setting and

      $$\left[\frac{di}{dt}\right]_{t=0} \geq 1{,}7 \text{ kA/ms}$$

   2) circuit-breakers with intended limitation of current rise during maximum fault test

      – cut-off current limiting circuit-breaker C;

      the C circuit-breaker limits the cut-off current before the short-circuit current to be interrupted reaches its maximum value; the C circuit breaker can be an air circuit breaker or a hybrid circuit breaker;

      Table 6 gives the maximum values of the cut-off current depending on the preferred values of rated short-circuit current together with the maximum allowable value of initial current rise;

      Table 6 applies to C circuit-breakers for nominal voltages up to and including 1 500 V.

Table 6 – Limits of the cut-off current of C circuit-breakers during maximum fault test

Short circuit current characteristics			Maximum cut-off current	
Rated short-circuit current	Initial rate of rise	Circuit time constant	Class C1	Class C2
I_{Nss}				
kA	kA/ms	ms	kA	kA
20	1,5	13,3	15	17
50	3	16,7	25	30
75	10	7,5	50	60
100	10	10,0	55	70

Smoothing reactors should be installed for substations in order to realize an initial rate of rise equal to or less than the applicable value given in Table 6.

c) Use (installation point) in the system:
   – interconnector circuit-breaker I (also called bus-section or section circuit-breaker);
   – line circuit-breaker L;
   – rectifier circuit-breaker R.

d) Current interruption direction:
   – unidirectional U;
   – fitted with a series unidirectional release U_1;
   – fitted with a series bidirectional release U_2;

   NOTE 3 U_2 circuit-breakers are used for application where the reverse fault current is low (distant fault current) and cannot operate the overload protection for normal discrimination purposes (i.e. substations where adjacent substations are a far distance away).

   – bidirectional B.

e) Duty of the main circuit

   NOTE 4 To be specified when different from 5.3.4.2 and Table 2.

f) Actuating of the closing and opening operations:
   – stored energy operation;
   – independent manual operation;
   – independent power operation;
   – use of magnet;
   – type of automatic tripping due to a release or relay;
   – interlocks for opening and/or closing operations;
   – trip-free provision;
   – anti-pumping device.

g) Relay or release type:
   – type of the relay(s) or release(s) involved.

h) Provision of an enclosure:
   – without provision of an enclosure O (see 3.3.16 of IEC 61992-1);
   – with provision of an integral enclosure E (see 3.3.17 of IEC 61992-1);
   – with provision of a separate protection enclosure P.

The purchaser shall indicate which characteristics are to be present in the required circuit-breaker(s) and only those tests which relate to the chosen type are applicable to the selected type of circuit-breaker.

The above designations are used in this standard and may be used elsewhere adopting the conventional grouping as given in Table 1.

Table 1 – Shortened type designation

Items above	b)	c)	~~D~~ d) [a]	~~H~~ h) [a]
Options	H V S C	/ I / L / R	/ U_1 / U_2 / B	/ O / E / P
Examples	H/L/B/E			
	V/I/P		S/R/O	
	H/R and L/U_2 [b]			
NOTE When a circuit-breaker is not suitable to perform all duties as given in 5.3.4.2, this fact will be indicated by means of the lower case letter(s) designating actual capability according to Table 2, first column (for example, H1/I ff, fr/P).				
[a] Optional designations. [b] When a circuit-breaker is or shall be suitable for multiple alternate functions, the indication of these functions shall be preceded by an "and".				

Where semiconductor circuit-breakers are only designed for use in rectifier equipped substations, they shall be clearly so marked. If they may also be used as track paralleling circuit-breakers, when the substation rectifier circuit-breakers are out of service, they shall also be clearly so marked.

5.3 Rated values and limit values for the main circuit

5.3.1 General

The rated characteristic values shall be specified by the purchaser. Nominal voltage values shall be selected from the values indicated in Table 1 of IEC 61992-1; current values and track time constant (based on the track configuration which gives the largest track time constant) should have one of the preferred values listed in 5.1.2 of IEC 61992-1.

These values should be confirmed by the supplier, who should indicate the rated values for the type of circuit-breaker proposed and supply any other relevant data.

All these values shall be stipulated in accordance with 5.3.2 to 5.3.4. Definitions are given in IEC 61992-1. Some data may be omitted by agreement.

5.3.2 Voltages

A circuit-breaker is identified by the following voltages:

– system voltages and limits (see 3.2.1 and 5.1.3 of IEC 61992-1);
– nominal voltage U_n (see IEC 60850);
– rated voltage U_{Ne} (see 3.2.1.4 of IEC 61992-1);
– rated insulation voltage U_{Nm} (see 3.2.1.3 of IEC 61992-1). It shall be equal to or higher than U_{max};

– rated impulse withstand voltage U_{Ni} (see 3.2.1.7 of IEC 61992-1);

– power-frequency voltage withstand level (dry) U_a (see 3.2.1.8 and Table 1 of IEC 61992-1);

– maximum arc voltage (see 3.2.1.10 of IEC 61992-1);

– rated auxiliary and control supply voltages (see 3.2.1.5 of IEC 61992-1).

5.3.3 Currents

A circuit-breaker is defined by the following currents:

– conventional thermal current I_{th}, I_{the} (see 3.2.3 and 3.2.4 of IEC 61992-1);

– rated service current I_{Ne} (see 3.2.5 of IEC 61992-1);

– rated short-circuit current I_{Nss} (see 3.2.10 of IEC 61992-1);

– rated short-time withstand current I_{Ncw} (see 3.2.7 of IEC 61992-1);

NOTE 1 Short-time ratings only apply to circuit-breakers not fitted with series trip devices, or in a unidirectional device where a series trip is inoperative. In practice, this would apply to a rectifier circuit-breaker in the forward direction where a series trip only acts in the reverse direction.

NOTE 2 Rated short-time currents do not need to have the same value as the rated short-circuit current I_{Nss}.

– overload capability: the purchaser shall inform the supplier of the load cycle requirements (see 3.2.5, Note 2 of IEC 61992-1).

5.3.4 Short-circuit characteristics

5.3.4.1 Rated short-circuit breaking and making capacities

These values are defined in 3.2.19 and 3.2.23 of IEC 61992-1 and are associated with the rated voltage U_{Ne}, the rated service current I_{Ne}, the rated short-circuit current I_{Nss}, the rated track time constant T_{Nc} and the class designation H ~~or~~ , V ~~or~~ , S or C.

The rated short-circuit making capacity is the prospective peak value of the rated short-circuit current I_{Nss} (see 3.2.10 of IEC 61992-1).

A rated short-circuit breaking capacity requires the circuit-breaker to be able to interrupt any short-circuit current of a value lower than or equal to this rated breaking capacity at the circuit time constant stipulated.

~~A~~ H, V and S circuit-breaker~~s~~ having a breaking capacity at a rated track time constant T_{Nc} ~~is~~ are capable of the same breaking capacity at all lower values of ~~track~~ circuit time constant ~~T_c~~ t_c. For Type C circuit breakers the initial rate of rise shall not exceed the limits given in Table 6.

The prospective maximum short-circuit current is the sum of the prospective short-circuit currents from all sources connected to the system, including rectifier converters and regenerative trains.

When fixing the maximum short-circuit current and the above track time constant, Clause 5 of IEC 61992-1 shall be considered.

5.3.4.2 Duties and test duty cycles

The duties required of a circuit-breaker for each of the three uses are listed in Table 2. The test duty cycles applying to the duties are shown in Table 3.

NOTE Where the circuit-breaker chosen by the manufacturer or offered by the supplier has been designed with short-circuit breaking characteristics in excess of those actually required in the installation, it may be agreed between purchaser and supplier to perform additional tests in accordance with 8.3.8 for duties f) and/or e) and/or d) using the test current actually required. These tests may be performed either at a standard test duty cycle (duty 1 ~~or~~ , duty 2 or duty 3) or at an agreed duty cycle and may be repeated a number of times upon agreement between purchaser and supplier.