IEC 61992-2

Edition 2.0 2014-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

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(en-fr)

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 14 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
More than 55 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue
Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,…). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org
Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 14 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary
Plus de 55 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

IEC 61992-2

Edition 2.0 2014-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

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

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX

M

ICS 45.060

ISBN 978-2-8322-1527-2

FOREWORD

This amendment has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

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

CDV	Report on voting
9/1791/CDV	9/1851/RVC

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

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability 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

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

2 Normative references

Add "+ A1:2014" to IEC 61992-1:2006

5.2 Type of circuit-breaker

Replace 5.2 b) by:

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 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 I_{Nss} kA	Initial rate of rise kA/ms	Circuit time constant ms	Class C1 kA	Class C2 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.

Replace existing Table 1 by the following new Table 1:

Table 1 – Shortened type designation

<table>
<tr><th>Items above</th><th>b)</th><th>c)</th><th>d) [a]</th><th>h) [a]</th></tr>
<tr><td>Options</td><td>H
V
S
C</td><td>I
L
R</td><td>U_1
U_2
B</td><td>O
E
P</td></tr>
<tr><td rowspan="3">Examples</td><td colspan="4">H/L/B/E</td></tr>
<tr><td colspan="2">V/I/P</td><td colspan="2">S/R/O</td></tr>
<tr><td colspan="4">H/R and L/U2 [b]</td></tr>
<tr><td colspan="5">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).</td></tr>
<tr><td colspan="5">[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”.</td></tr>
</table>

5.3.4.1 Rated short-circuit breaking and making capacities

Replace, in the first paragraph, "designation H or V or S" by "designation H, V, S or C".

Replace the 4th paragraph by the following:

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

5.3.4.2 Duties and test duty cycles

Add, in the last sentence of the Note,“duty 3” as follows:” (duty 1, or duty 2, or duty 3)”.

Replace existing Table 2 by the following new Table 2:

Table 2 – Circuit-breaker duties

Duty	Use	Conditions	Test current	Prospective peak	Time constant
f	L	Maximum fault	I_{Nss}	Type H, V and S: ≥1,42 × I_{Nss}	By consequence of other circuit parameters
				Type C: ≥ I_{Nss}	See Table 6
e	L [a]	Maximum energy	0,5 × I_{Nss}	By consequence of other circuit parameters	0,5 × T_{Nc}
d	L	Distant fault	2 × I_{Ne}	By consequence of other circuit parameters	T_{Nc}
l	L	Low current	I_c	Not applicable	≅0,01 s
ff	l	Maximum fault forward	I_{Nss}	Type H, V and S: ≥1,42 × I_{Nss}	By consequence of other circuit parameters
				Type C: ≥ I_{Nss}	See Table 6
fr	l	Maximum fault reverse	I_{Nss}	Type H, V and S: ≥1,42 × I_{Nss}	By consequence of other circuit parameters
				Type C: ≥ I_{Nss}	See Table 6
lr	l R [b]	Forward low current after reverse short circuit	I_c	Not applicable	≅0,01 s
r	R	Maximum fault reverse with paralleled converters	I_{Nss}	≥1,42 × I_{Nss} [c]	
s	R	Short time current forward	I_{Ncw}	≥1,42 × I_{Ncw} [c]	

NOTE 1 For substations equipped with smoothing reactors of high value, the maximum energy condition may correspond to the maximum fault condition.

NOTE 2 I_{Nss} is to be determined for each type of actual circuit situation. Therefore, I_{Nss} may be different for Line L, Interconnector I and Rectifier R circuit-breakers.

[a] The factor affecting both I_{Nss} and T_{Nc} for maximum energy fault position is taken for practical reasons as 0,5. For low values of T_{Nc}, see Table 2 of IEC 61992-1.

[b] R only when explicitly required by the purchaser.

[c] The coefficient is 1 with regard to the C circuit-breaker.

Replace existing Table 3 by the following new Table 3:

Table 3 – Test duty cycles

Duty	Breaking characteristics	Test cycle	
f, e, d	H,V,S [a]	Duty 1	O – 15 s – CO – 15 s – CO – 60 s – CO
		Duty 2	O – 7 s – CO – 10 s – CO – 60 s – CO
	C [b]	Duty 3	O – 10 s – CO [c]
ff, fr, r	H,V,S,C	O – 15s – CO	
l, lr	H,V,S,C	10 times (O – 120 s – CO)	
s	H,V,S,C	Carrying for 0,25 s	

NOTE 1 O = opening operation, CO = closing operation.

NOTE 2 First opening is made on a short circuit being established.

[a] The choice of Duty 1 or 2 is left to the purchaser. If no choice is made, then the duty cycle required is Duty 1.

[b] In the case of C, the test cycle of duty e and d are subject to agreement between purchaser and supplier.

[c] The standard duty is O – 10 s – CO. However, if AC short-circuit test method is applied, the duration between O and CO may be reduced to less than 10 s.

8.2 Applicable tests and test sequence

Replace existing Table 4 by the following new Table 4:

Table 4 – List of applicable tests and sequence

Group	Test description	Kind	Reference to subclause
1	General operating characteristics		
	Verification of conformity to the manufacturing drawings and to characteristics of the circuit-breaker	Type and routine	8.3.1
	Mechanical operation	Type and routine	8.3.2
	Dielectric withstand	Type and routine	8.3.3
	Temperature-rise	Type	8.3.4
	Verification of the adjustment of the relays and releases	Routine	8.3.5
	Electrical endurance	Type	8.3.6
	Mechanical endurance	Type	8.3.7
2	Short circuit behaviour		
	Verification of the H, V or S characteristic	Type	8.3.8.1
	Verification of the C characteristic	Type	8.3.8.9
	Verification of the short-time withstand current of rectifier circuit-breakers R	Type	8.3.9
	Verification of the adjustment of the relays and releases	Type	8.3.5
3	Search for critical currents and low current test duty	Type	8.3.10

8.3.8 Verification of the making and breaking capacity in short-circuit conditions and of the H, V or S characteristic

Replace the title of subclause 8.3.8 by:

8.3.8 Verification of the making and breaking capacity in short-circuit conditions

8.3.8.1 Tolerances on the test values

Replace the title of subclause 8.3.8.1 by:

8.3.8.1 Verification of the H, V or S characteristic

Add new subclause 8.3.8.9, between 8.3.8.1 and 8.3.8.2:

8.3.8.9 Verification of the making and breaking capacity in short-circuit conditions and of the C characteristic

8.3.8.9.1 Tolerances on the test values

This test is carried out at the values indicated by the manufacturer in 5.3.1 to 5.3.3 in accordance with 5.3.4. The test is considered valid if the reported values differ from stated values within the limits stated in Table 6 of IEC 61992-1:2006 except for the time constant. The tolerances of the initial rate of rise shall be 0 ~ +30 % and as a consequence the tolerances for the time constant are –30 % ~ 0.

For laboratory reasons, these tolerances may be revised by mutual agreement.

8.3.8.9.2 Test conditions

The circuit-breaker shall be a complete assembly. The control device, except for control motors, shall be supplied at its minimum voltage value, as stated in 5.4.

The circuit-breaker should be tested in an enclosure having the minimum volume and dimensions as declared by the manufacturer, or in open air when intended for cell use, using screens to simulate the closest proximity of cell walls and ceiling. These screens or cubicle shall be metal and connected to the circuit-breaker earthed frame. Screens and cubicles may be lined with insulation if this is the manner in which the circuit-breaker operates in service.

8.3.8.9.3 Procedure

The test, as specified in 5.3.4, consists of a number of duties particular to a class of circuit-breaker with an appropriate duty cycle and release setting. Each duty cycle is required to be performed once and, because of the severe nature of the test, the circuit-breaker may be maintained between duty cycles.

In the case of adopting Duty 3 in Table 3, test cycle O – 10 s – CO shall be carried out once. For laboratory reasons, the time between O and CO may be shorter than 10 s by mutual agreement (See Table 3, note b).

Where a circuit-breaker can have applications of either of its primary terminals connected to the positive supply, then the test duties f), e) and d) (see Table 3) shall be repeated for both connections.

After each test duty, a dielectric test is required in accordance with 7.6.3 of IEC 61992-1:2006.

8.3.8.9.4 Test circuit

A typical arrangement of the test circuit is shown in Annex A of IEC 61992-1:2006.

Details of the test circuit are given in 7.6.1 of IEC 61992-1:2006.

For laboratory reasons, the AC short-circuit test method may be applied by mutual agreement (see Annex B).

For test duties e) and d), where insufficient impedance can be added to the load side, then the test duty shall be repeated with the live connection to the opposite terminal. Thus both terminals of the circuit-breaker are stressed to earth during extinguishing of arc.

8.3.8.9.5 Time constant of the test circuit

The test circuit time constant is as follows (see Table 2).

a) For the maximum fault test the circuit time constant shall be the value given in Table 6.

b) For the maximum energy, the circuit time constant shall be equal to or higher than half of the rated time constant T_{Nc} (For the actual value see 5.1.1.3 of IEC 61992-1:2006).

c) For the distant fault, the circuit time constant t_c should be equal to the rated time constant T_{Nc}.

d) For the electrical endurance test, the circuit time constant t_c should be set at 0,01 s.

e) For the critical current test, the circuit time constant t_c should be as close to 0,01 s as possible.

When calibrating each test, the test circuit time constant or the initial rate of rise shall be measured. The time constant is taken from the test current. (See the calibration waveform 2 in IEC 61992-1:2006, Table A.2.)

In the case of adopting the AC short-circuit test method, Annex B should be referred.

8.3.8.9.6 Recovery voltage

For the test, the average value of the recovery voltage shall be not lower than the rated voltage U_{Ne}. In the case of adopting the AC short-circuit test the test conditions given in Clause B.3 may apply.

8.3.8.9.7 Details for conducting the tests

8.3.8.9.7.1 Calibration of the test circuit

The test shall be performed at the rated voltage U_{Ne}, calibrated with the test unit A replaced by a provisional connection B of negligible impedance in respect to the test circuit.

Adjust resistors R and reactors L in order to obtain both the sustained short-circuit current and the rated time constant. These values are for the prospective current and shall be those declared by the manufacturer, within the tolerances stated in 7.2 of IEC 61992-1:2006 (see 8.3.8.1).

In the case of adopting the AC short-circuit test method, Annex B should be referred.

8.3.8.9.7.2 Performance of the tests

Replace the provisional connection B by the test unit A, with the terminals of the circuit-breaker connected as required by the test duty. The tests shall comply with 8.3.8.3 and with the conditions specified in 7.6.2 of IEC 61992-1:2006.

After the current interruption, the recovery voltage shall be maintained for 0,1 s.

If the test is performed as AC test the recovery voltage time may be less than 0,1 s by mutual agreement.

8.3.8.9.7.3 Behaviour of the circuit-breaker during the making and breaking short circuit tests

During the test the circuit-breaker shall break the short-circuit current; there shall be no re-ignition after current zero. The short-circuit current shall be the rated short-circuit current.

The circuit-breaker shall achieve the values given in Table 7.

Table 7 – Verification of the behaviour of the circuit-breaker when performing test duties f, ff and fr

Type	Opening time ms	Total break time ms	Current setting kA	Initial rate of rise kA/ms	Cut off current kA
C	Not applicable	Not applicable	Maximum value	Equal to or higher than the value given in Table 6	Equal to or less than the value given in Table 6

The fuse element in the protection device D shall not blow during the test.

The cut-off current shall be verified.

8.3.8.9.7.4 Conditions of the circuit-breaker after the above test

These shall be in accordance with the conditions specified in 7.6.3 of IEC 61992-1:2006.

8.3.8.9.8 Verification of the C characteristic for test duties f, ff and fr

During the maximum fault test for test duties f, ff and fr, the behaviour of the circuit-breaker in meeting its class designation of C shall be verified only if the test currents and settings are as given in Table 7.

The cut-off current of the circuit-breaker shall be as given in Table 7.

8.3.10 Searching for critical currents and performing test duty l) and lr)

Replace the third paragraph by:

For L circuit-breakers test duty l is performed at the value of critical current I_c determined for unidirectional circuit-breakers U_1 and U_2 as described in Clause C.2 of IEC 61992-1:2006 for bidirectional circuit-breakers B as described in Clause C.3 of IEC 61992-1:2006.

Delete Note 1.

Replace the fourth paragraph by:

For R and I circuit-breakers test duty lr is performed at the value of critical current I_c determined as described in Clause C.3 of IEC 61992-1:2006.

Add the following new Annex B:

Annex B
(normative)

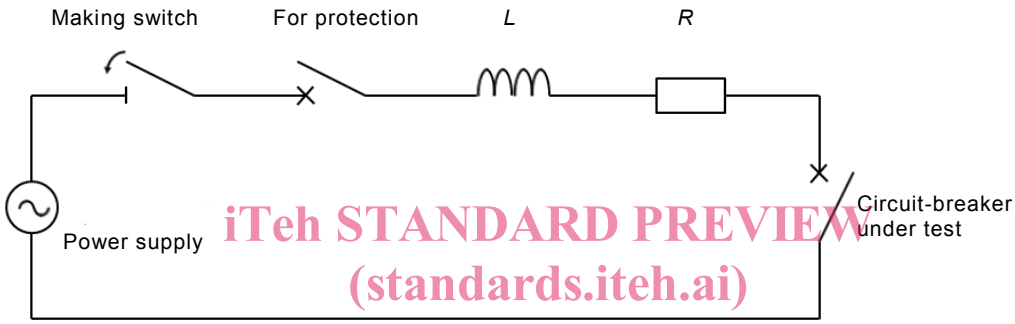
AC short-circuit test method

B.1 General

For circuit-breaker C, this annex gives the alternative AC method for the making and breaking short circuit tests specified in 8.3.8.9.

B.2 Test circuit

The conditions of the AC short-circuit test corresponding to the DC short-circuit test are as follows (see Figure B.1).



Key

L circuit inductance

R circuit resistance

Figure B.1 – Test circuit

Typical voltage and current waveforms of the AC short-circuit test are as follows (see Figure B.2):