



SLOVENSKI STANDARD  
SIST EN 50152-1:1998

01-november-1998

Železniške aplikacije - fiksne naprave - posebne zahteve za a.c. stikalnico --  
Del 1: Enofazni ločevalniki s U<sub>m</sub> nad 1 kV

Railway applications - Fixed installations - Particular requirements for a.c. switchgear --  
Part 1: Single-phase circuit-breakers with U<sub>m</sub> above 1 kV

Bahnanwendungen - Ortsfeste Anlagen - Besondere Anforderungen an Wechselstrom-  
Schalteinrichtungen -- Teil 1: Einphasen-Leistungsschalter mit U<sub>m</sub> über 1 kV  
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**ICS:**

29.130.99	Druge stikalne in krmilne naprave	Other switchgear and controlgear
29.280	Elektromotorski in električni pogonski opremljeni vozila	Electric traction equipment

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 50152-1**

June 1997

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ICS 29.120.60; 45.020

Descriptors: Railway fixed equipment, electric traction, a.c., electric switchgear, circuit-breaker, definition, characteristic, test, requirement

English version

**Railway applications - Fixed installations  
Particular requirements for a.c. switchgear  
Part 1: Single-phase circuit-breakers with  $U_m$  above 1 kV**

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**CENELEC**

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

Page 2  
EN 50152-1:1997

### Foreword

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

The text of the draft was submitted to the unique acceptance procedure and was approved by CENELEC as EN 50152 on 1996-10-01.

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) 1997-12-01
- latest date by which the national standards conflicting  
with the EN have to be withdrawn (dow) 1997-12-01

This Part 1 is to be used in conjunction with HD 348 S6:1995.

Annexes designated "informative" are given for information only.  
In this standard, annex A is informative.

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**Contents**

<b>I SERVICE CONDITIONS, DEFINITIONS, RATING, CONSTRUCTION AND DESIGN</b>	
1	Scope ..... 6
2	Normal and special service conditions ..... 6
3	Definitions ..... 6
4	Rating ..... 7
5	Desing and construction ..... 19
<b>II TEST, SELECTION, ORDERS AND INSTALLATION</b>	
6	Type tests ..... 22
7	Routine tests ..... 54
8	Guide to the selection of circuit-breakers for service ..... 56
9	Information to be given with enquiries, tenders and orders ..... 56
<b>III ANNEXES</b>	
Annex A	<b>iTeh STANDARD PREVIEW</b> <b>(standards.iteh.ai)</b> ..... 58

SIST EN 50152-1:1998

<https://standards.iteh.ai/catalog/standards/sist/dcd3f5a2-91df-4ded-8c1e-377723fc20b/sist-en-50152-1-1998>

## Introduction

This standard is divided into two parts:

- Part 1 gives requirements for single-phase circuit-breakers with  $U_m$  above 1 kV.
- Part 2 gives requirements for single-phase disconnectors, earthing switches and switches with  $U_m$  above 1 kV.

EN 50152-1 has to be used in conjunction with HD 348 S6:1995 *High-voltage alternating-current circuit-breakers* (IEC 56:1997 + A1:1992).

The essential requirements of HD 348 S6 have been transcribed in the document. Other complementary clauses of HD 348 S6 are mentioned in this standard. Where a particular subclause of HD 348 is not mentioned, but is not referred as "void" in this standard, that subclause applies as far as reasonable. Where this standard states "addition" or "replacement", the relevant text of HD 348 S6 is to be adapted accordingly.

NOTE 1: Where terms defined in HD 348 S6 conflict with definitions of the same terms as given in IEC 50(811):1991 or of the other railway applications documents listed in the normative references, the definitions used in HD 348 S6:1995 are to be used.

NOTE 2: The suffix *N* which appears in this Standard for rated values is not present in HD 348 S6.

The following print types are used:

- 1) Roman numbers and capital bold type for chapters of HD 348 and IEC 56;
- 2) Arab numbers and capital bold type for clauses of HD 348 and IEC 56;
- 2) Arab numbers and bold italic/roman type for other titles;
- 3) Roman type for requirements;
- 4) *Italic type for text specifications*;
- 5) small Roman types for explanations.

Normative references are referred in this introduction. Other documents applicable to this equipment when used for railway applications are listed in annex A.

**Normative references**

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

EN 50124-1	199X <sup>1)</sup>	Railway applications - Insulation co-ordination - Part 1: Basic requirements - Clearances and creepage distances
EN 50163	1995	Railway applications - Supply voltages of traction systems
EN 60068-2 HD 323.2	series series	Environmental testing - Part 2: Tests (IEC 68-2 series)
EN 60129 +A1 +A2	1994 1994 1996	Alternating current disconnectors and earthing switches
EN 60137	1996	Insulated bushings for alternating voltages above 1 kV (IEC 137:1995)
EN 60427	1992	Synthetic testing of high-voltage alternating current circuit-breakers (IEC 427:1989)
EN 60507	1993	Artificial pollution tests on high-voltage insulators to be used on a.c. systems (IEC 507:1991)
HD 60694	1996	Common clauses for high-voltage switchgear and controlgear standards (IEC 694:1996)
HD 348 S6	1995	High-voltage alternating-current circuit-breakers (IEC 56:1987 + A1:1992 + A2:1995, mod.)
HD 478.2	series	Classification of environmental conditions - Part 2: Environmental conditions appearing in nature (IEC 721 series)
HD 553 S2	1993	Current transformers (IEC 185:1987 + A1:1990, modified)
HD 566 S1	1990	Thermal evaluation and classification of electric insulation (IEC 85:1984)
HD 588.1 S1	1991	High-voltage test techniques - Part 1: General definitions and test requirements (IEC 60-1:1989 + corrigenda March 1990 + March 1992)
IEC 50(605)	1983	International Electrotechnical Vocabulary (IEV) Chapter 605: Generation, transmission and distribution of electricity - Substations
IEC 50(811)	1991	Chapter 811: Electric traction
IEC 815	1986	Guide for the selection of insulators in respect of polluted conditions

<sup>1)</sup> in preparation.

## I SERVICE CONDITIONS, DEFINITIONS, RATING, CONSTRUCTION AND DESIGN

### 1 SCOPE

This EN 50152-1 is applicable to single-phase a.c. one-pole circuit-breakers designed for indoor or outdoor fixed installations for operation at frequencies of 16 2/3 Hz and 50 Hz on traction systems having an  $U_{Nm}$  above 1 kV up to 52 kV.

This EN 50152-1 is also applicable to two-pole circuit-breakers when connected in the following manner: one pole supplying the connection to the contact line of the track, the second pole supplying the connection to the feeder cable which runs alongside the same track and which is used to boost the track voltage at regular intervals in combination with autotransformers. The centre of this circuit is connected to earth.

This standard is also applicable to the operating devices of circuit-breakers and to their auxiliary equipment.

This standard does not address circuit-breakers with dependent manual operating mechanism.

NOTE: A rated short-circuit making current cannot be specified for these circuit-breakers and the use of these mechanisms may give reasons for the objection based on their safety in operation.

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### 2 NORMAL AND SPECIAL SERVICE CONDITIONS

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Clause 2 of EN 60694:1996 is applicable except as follows:

*Addition:* <https://standards.iteh.ai/catalog/standards/sist/dcd3f5a2-91df-4ded-8c1e-3777723fc20b/sist-en-50152-1-1998>

The equipment covered by this Standard is suitable for installation in trackside substations subject to vibrations from passing trains, airborne iron dust contamination from train brakes and meets electromagnetic compatibility (EMC) requirements.

For special service conditions, agreement is necessary between purchaser and supplier.

### 3 DEFINITIONS

#### 3.101 to 3.104.32

These subclauses of HD 348 S6:1995 are applicable.

*Addition:*

#### 3.104.33 *Device for partial precharging*

A device which provides a partial precharging of the closing mechanism when the circuit-breaker is open. Completion of charging and closing of the circuit-breaker is accomplished at the closing command.

NOTE: This device will be specified by the purchaser when it is required.



**3.105 to 3.105.53**

These subclauses of HD 348 S6:1995 are applicable.

*Addition:*

**3.105.54 *Single-pole circuit-breaker***

A circuit-breaker with one electrically separated conducting path for the main circuit suitable for use in a single phase circuit.

NOTE: The construction arrangement of this device is in principle identical to one phase of a three-phase circuit-breaker.

**3.105.55 *Two-pole circuit-breaker***

A circuit-breaker with two independent electrically separated conducting paths for the main circuit.

NOTE 1: The two paths may be connected in series for use in a single phase circuit where the establishment and the separation of the two paths is simultaneous.

NOTE 2: The construction arrangement of this device is in principle identical to two phases of a three phase circuit-breaker.

**3.106 *Index of definitions***

Same as in 3.106 of HD 348 S6:1995, but amended according to the three additional definitions above.

**4 RATING**

A circuit-breaker in correct condition of maintenance and adjustment shall be able to withstand all stresses that occur in service provided that these do not exceed its rated characteristics.

The characteristics of a circuit-breaker, including its operating devices and auxiliary equipment, that shall be used to determine the rating are the following:

**(A) *Rated characteristics to be given for all circuit-breakers***

- a) Rated voltage.
- b) Rated insulation level.
- c) Rated frequency.
- d) Rated normal current.
- e) Rated short-time withstand current.
- f) Rated peak withstand current.
- g) Rated duration of short circuit, for circuit-breakers not fitted with direct over-current release.
- h) Rated supply voltage of closing and opening devices and of auxiliary circuits.
- i) Rated supply frequency of closing and opening devices and of auxiliary circuits.
- j) Rated pressures of compressed gas supply for operation and for interruption, if applicable.
- k) Rated gas pressure for sealed gas pressure devices.
- l) Rated short-circuit breaking current.
- m) Rated transient recovery voltage for terminal faults.
- n) Rated short-circuit making current.
- o) Rated operating sequence.

#### 4.1 Rated voltage ( $U_{Ne}$ )

The rated voltage  $U_{Ne}$  shall be chosen taking into consideration the maximum voltage level suitable to be permanently applied to the circuit-breaker (i.e. highest permanent voltage  $U_{max1}$  as defined in EN 50163).

NOTE: This standard makes reference to the values  $U_{max1}$  and  $U_{max2}$ , taken from EN 50163. These values are used to express the values of  $U_{Ne}$ , which are expected to be equal or higher than  $U_{max1}$ . The insulation characteristics are also expected to be suitable to allow, when required in clause 4 and clause 6, the highest non-permanent voltage  $U_{max2}$ .

##### 4.1.1 Nominal voltage ( $U_n$ )

The nominal voltage  $U_n$  shall be one of the voltages listed in EN 50124-1 which have been selected from EN 50163, according to the table Z1.

#### 4.2 Rated insulation level ( $U_{Nm}$ )

The value of the rated insulation level  $U_{Nm}$ , of the rated impulse withstand voltage  $U_{Ni}$  and of the power-frequency test voltage  $U_a$  shall be as given in table Z.1, taken from the values listed in EN 50124-1.

**Table Z1: Nominal voltages ( $U_n$ ), rated impulse voltages ( $U_{Ni}$ ) and short-duration power-frequency (A.C.) test levels  $U_a$  (kV r.m.s) for circuits connected to the contact line**  
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$U_n$ (kV)	$U_{nm}$ (kV)	$U^{1)}$ (kV)	$OV$ (kV)	$U_{Ni}$ (1,2/50 $\mu$ s) (kV)	$U_a$ (kV)
EN 50163	EN 50124	(EN 60694)	EN 50124-1		
15	17,5	(24,0)	3	95	38 or 50 <sup>2)</sup>
			4	125	50
25	24,0	(36,0)	3	145	70
			4	170	70 or 95 <sup>2)</sup>
	27,5 <sup>3)</sup>	N/A	3	170	70 or 95 <sup>2)</sup>
			4	200 <sup>3)</sup>	95
Note 3	52,0	(72,5)	3	250	95
			4	300	140

1) The values in brackets give the nearest equivalence in test withstand values with EN 60694.  
2) These values are used in railway application only and are not of wide industrial use.  
3) At purchaser choice or by agreement

NOTE 1: The choice of the different values of  $U_{Ni}$  given for the same  $U_n$ , depends upon the highest non-permanent voltages (such as  $U_{max2}$  of EN 50163) actually appearing in the system.

NOTE 2: OV3 and OV4 are overvoltage levels depending on the system configuration and degree of overvoltage control (inherent control or protective control) as given in EN 50124-1.

NOTE 3: Take care that in those cases in which for circuit reasons it may happen that a higher voltage is applied to the device terminals in transient conditions a higher rated insulation voltage between contacts might be necessary (e. g.  $U_{Nm} = 52$  kV for  $U_n = 25$  kV).

#### **4.3 Rated frequency**

Subclause 4.3 of EN 60694 is applicable.

In railway applications the rated frequency 16 2/3 Hz applies as an alternative to 50 Hz.

#### **4.4 Rated normal current and temperature rise**

Subclauses 4.4.1 and 4.4.2 of EN 60694 are applicable with the following additions:

The values of rated currents shall be selected from the following standard values:

400 A; 630 A; 800 A; 1 250 A; 1 600 A; 2 000 A; 2 500 A; 4 000 A.

NOTE: The above values are selected from the R 10 series and, if required, higher values than those shown should also be selected from this series.

If the circuit-breaker is fitted with a series connected accessory, such as a direct over-current release, the rated normal current of the accessory is the r.m.s. value of the current which the accessory shall be able to carry continuously without deterioration at its rated frequency, with a temperature rise not exceeding the values specified in table 3 of EN 60694.

Current transformers shall comply with HD 553 S2.

#### **4.5 Rated short-time withstand current**

Subclause 4.5 of EN 60694 is applicable with the following addition:

The rated short-time withstand current is equal to the rated short-circuit breaking current (see 4.101).

#### **4.6 Rated peak withstand current**

Subclause 4.6 of EN 60694 is applicable with the following addition:

The rated peak withstand current is equal to the rated short-circuit making current (see 4.103).

#### **4.7 Rated duration of short-circuit**

Subclause 4.7 of EN 60694 is applicable with the following addition:

A rated duration of a short-circuit need not be assigned to a circuit-breaker fitted with a direct over-current release provided that, when connected in a circuit the prospective breaking current of which is equal to its rated short-circuit breaking current, the circuit-breaker shall be capable of carrying the resulting current for the break-time required by the circuit-breaker with the over-current release set for the maximum setting and maximum time delay if adjustable, when operating in accordance with its rated operating sequence (see 6.5.1).

**4.8 Rated supply voltage of closing and opening devices and auxiliary circuits**

Subclause 4.8 of EN 60694 is applicable with the following addition:

The specified upper limit of the supply voltage for a closing solenoid shall be 105 % of the rated supply voltage.

**4.9 Rated supply frequency of closing and opening devices and auxiliary circuits**

Subclause 4.9 of EN 60694 is applicable.

In railway applications the rated frequency 16 2/3 Hz applies as an alternative to 50 Hz.

**4.10 Rated pressures of compressed gas supply for operation and for interruption**

The value of the pressures to which the circuit-breaker is filled.

Subclause 4.10 of EN 60694 is applicable to the pressure of the compressed gas supply for operation.

No standard values are given for rated pressure of compressed gas supply for interruption.

**4.101 Rated short-circuit breaking current ( $I_{Nss}$ )****4.101.1 General**

The rated short-circuit breaking current ( $I_{Nss}$ ) is the highest short-circuit current which the circuit-breaker shall be capable of breaking under the conditions of use and behaviour prescribed in this standard in a circuit having a power frequency recovery voltage corresponding to the rated voltage of the circuit-breaker and having a transient recovery voltage equal to the rated value specified in 4.102.

Short-line fault interruption is not a requirement for circuit-breakers to this standard. Such a requirement shall be deemed to be special and subject to agreement between purchaser and supplier.

The rated short-circuit breaking current is characterized by two values:

- the r.m.s. value of its a.c. component, termed "rated short-circuit current" for shortness, and
- the percentage d.c. component.

NOTE 1: If the d.c. component does not exceed 20 %, the rated short-circuit breaking current is characterized only by the r.m.s. value of its a.c. component.

For determination of the a.c. and d.c. components, see figure 8 of HD 348 S6:1995 (page 98 of IEC 56:1987).

The circuit-breaker shall be capable of breaking any short-circuit current up to its rated short-circuit breaking current containing any a.c. component up to the rated value and associated with it any percentage d.c. component up to that specified, under the conditions mentioned above.

The following applies to a standard circuit-breaker:

- a) At voltages below the rated voltage, it will be capable of breaking its rated short-circuit breaking current.

NOTE 2: For circuit-breakers having proved rated short-circuit breaking currents  $I_{Nss}$  at two different rated voltages  $U_{Ne}$ , intermediate characteristics may be assigned from the straight line drawn between the two proved rating points on a plot of  $\log U$  versus  $\log I$ . In case of doubt, tests should be carried out to check the validity of the interpolation.

- b) At voltages above the rated voltage, no short-circuit breaking current is guaranteed except to the extent provided for in 4.106.

#### 4.101.2 A.C. component of the rated short-circuit breaking current

The r.m.s. value of the a.c. component of the rated short-circuit breaking current shall be selected from the values shown in table X.

NOTE: The values in table X are selected from the R 10 series, and, if required, higher values than those shown should also be selected from this series.

#### 4.101.3 D.C. component of the rated short-circuit breaking current

The value of the percentage d.c. component shall be determined as follows:

- a) For a circuit breaker which can be tripped by a short-circuit current without the aid of any form of auxiliary power, the percentage d.c. component shall correspond to a time interval  $\tau$  equal to the minimum opening time of the circuit breaker.

- b) For a circuit breaker which can be tripped solely by a form of auxiliary power, the percentage d.c. component shall correspond to a time interval  $\tau$  equal to the minimum opening time of the circuit breaker plus one-half cycle of rated frequency.

The minimum opening time mentioned above is the shortest opening time of the circuit breaker obtainable under any service conditions whether in a breaking operation or a make-break operating cycle.

The percentage value of the d.c. component is dependent on the time interval  $\tau$  and standard values are given in figure 9 of HD 348 S6 (page 99 of IEC 56:1987).

#### 4.102 Rated transient recovery voltage for terminal faults

The rated transient recovery voltage (TRV) for terminal faults, relating to the rated short-circuit breaking current in accordance with 4.101, is the reference voltage which constitutes the limit of the prospective transient recovery voltage of circuits which the circuit-breaker shall be capable of breaking in the event of a short-circuit at its terminals.

##### 4.102.1 Representation of transient recovery voltage waves

The wave form of transient recovery voltages varies according to the arrangement of actual circuits.

NOTE 1: The transient recovery voltage approximates to a damped single frequency oscillation. This wave form is adequately represented by an envelope consisting of two line segments defined by means of two parameters.

\* Methods of drawing TRV envelopes are given in appendix FF.

The influence of local capacitance on the source side of the circuit-breaker produces a slower rate of rise of the voltage during the first few microseconds of the TRV. This is taken into account by introducing a time delay.

It appears that every part of the TRV wave may influence the interrupting capability of a circuit-breaker. The very beginning of the TRV may be of importance for some types of circuit-breakers.

NOTE 2: This part of TRV, called initial TRV (ITRV), is caused by the initial oscillations of small amplitude due to reflections from the first major discontinuity along the busbar. The ITRV is a physical phenomenon which is very similar to the short-line fault. Compared with the short-line fault, the first voltage peak is rather low, but the time to the first peak is extremely short, that is within the first microseconds after current zero. Therefore the thermal mode of interruption may be influenced.

NOTE 3: Since the ITRV is proportional to the busbar surge impedance and to current, the ITRV requirement can be neglected for metal-enclosed switchgear and in most railway applications, because of the low surge impedance and for all switchgear with a rated short-circuit breaking current of less than 50 kA.

NOTE 4: If the circuit-breaker has a short-line fault rating the ITRV requirements are considered to be covered if the short-line fault tests are carried out using a line without time delay (see 6.104.5.2).

#### 4.102.2 Representation of rated TRV

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The following parameters are used for the representation of rated TRV:

- a) Void. <https://standards.iteh.ai/catalog/standards/sist/dcd3f5a2-91df-4ded-8c1e-377723fc20b/sist-en-50152-1-1998>
- b) Two-parameter reference line (see figure 11 of HD 348 S6:1995 (page 100 of IEC 56:1987)):

$u_c$  = reference voltage (TRV peak value), in kilovolts  
 $t_3$  = time to reach  $u_c$ , in microseconds

- c) Delay line of TRV (see figure 11 of HD 348 S6:1995):

$t_d$  = time delay, in microseconds  
 $u'$  = reference voltage, in kilovolts  
 $t'$  = time to reach  $u'$ , in microseconds

the delay line starts on the time axis at the rated time delay and runs parallel to the first section of the reference line of rated TRV and terminates at the voltage  $u'$  (time-coordinate  $t'$ ).

- d) Void.

#### 4.102.3 Standard values of rated TRV

Standard values of rated TRV for single-phase circuit-breakers are given in table II.

Where the purchaser has requirements for higher severities of TRV than those in table II, these shall be identified in purchaser's specification.

**Table II: Standard values of rated transient recovery voltage  
Representation by two parameters - Single pole circuit-breaker**

$U_n$	$U_{\max 2}$ EN 50163	$U_c$ TRV peak value	$t_3$	$t_d$	$u'$	$t'$	$U_c/t_3$ rate of rise
kV	kV	kV	$\mu\text{s}$	$\mu\text{s}$	kV	$\mu\text{s}$	kV/ $\mu\text{s}$
15	18	36	108	16	12	52	0,33
25	29	57	132	20	19	64	0,43

With:

$$U_c = 1,4 \cdot \sqrt{2} \cdot U_{\max 2}$$

1,4 = amplitude factor (see HD 348 S6)

$$u' \approx U_c/3$$

$$t' = (t_3/3) + t_d$$

$$t_d = 0,15 \cdot t_3$$

NOTE 1: The values in table II are minimum values. The values of table II of HD 348 S6:1995 may be adopted with  $U$  (HD 348 S6) =  $\sqrt{3} U_{\max 2}$  and  $t_3$  unchanged.

NOTE 2: The TRV figures are for a single-pole circuit-breaker. The equivalent three-phase circuit-breaker is tested with  $u_c$  and  $U_c/t_3$  values equal to 1,5 times those shown in table II. Values for the time delay  $t_d$  are to be in accordance with table IIA of HD 348 S6:1995.

#### 4.102.4

Void.

#### 4.103 Rated short-circuit making current

The rated short-circuit making current (see figure 8 of HD 348 S6:1995 (page 98 of IEC 56:1987)) of a circuit-breaker is that which corresponds to the rated voltage, and shall be 2,5 times the r.m.s. value of the a.c. component of its rated short-circuit breaking current (see 4.101).

#### 4.104 Rated operating sequence

There are two alternative rated operating sequences as follows:

a) **O-t-CO-t'-CO**

Unless otherwise specified:

$$t = 180 \text{ s for circuit-breakers not intended for rapid auto-reclosing}$$

$$t = 0,3 \text{ s for circuit-breakers intended for rapid auto-reclosing (dead time)}$$

$$t' = 180 \text{ s}$$

NOTE: Instead of  $t' = 180 \text{ s}$ , other values:  $t' = 15 \text{ s}$  (for rated voltages less than or equal to 52 kV) and  $t' = 60 \text{ s}$  are also used for circuit-breakers intended for rapid auto-reclosing.