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IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

Corrigendum 1

IEEE Power Engineering Society

Sponsored by the
Switchgear Committee

IEEE
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New York, NY 10016-5997, USA

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Approved 8 March 2007

IEEE SA-Standards Board

Abstract: This corrigendum corrects technical and other non-editorial errors made during the preparation of IEEE Std C37.09-1999 latest version, second printing 19 December 2005, which covers test procedures for all high-voltage circuit breakers rated over 1000 VAC. This text also includes corrections to the errata dated 19 December 2005, which adjusts Figure 17 on page 62 of the main text (under 7.2).

As of the printing of this corrigendum, IEEE Std C37.09-1999 includes all of the following:

- IEEE Std C37.09-1999 latest version, second printing 19 December 2005;
- Errata to IEEE Std C37.09-1999 (edited 18 April 2007), which corrects typographical and editorial errors to the standard (note that these alterations have been made to the most current electronic version of the standard which is available online—http://shop.ieee.org/ieeestore/);
- IEEE Std C37.09a-2005, amendment to IEEE Std C37.09-1999, which adds additional content to the standard; and
- this corrigendum, IEEE Std C37.09-1999/Cor 1-2007, which makes technical corrections to both the original IEEE Std C37.09-1999 and the subsequently published errata.

Keywords: fast transient recovery voltage, indoor, initial, mechanical endurance, operating duty, outdoor, power frequency, short-circuit current, short-line fault, single-phase testing, test data reporting, three-phase testing, unit test, voltage distribution synthetic test

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Introduction

This introduction is not part of IEEE Std C37.09-1999/Cor 1-2007, IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis, Corrigendum 1.

This corrigendum corrects technical and other non-editorial errors printed in the text of the IEEE Std C37.09-1999, second printing 19 December 2005. It is recalled that IEEE Std C37.09a™-2005, IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis—Amendment 1: Capacitance Current Switching, which was printed and published on 16 September 2005, amends IEEE Std C37.09-1999.

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Contents

IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

Corrigendum 1

NOTE—The editing instructions contained in this corrigendum define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard.

The editing instructions are shown in ***bold italic*.** Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~strikethrough~~ (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editorial notes will not be carried over into future editions because the changes will be incorporated into the base standard.

Abstract

Change the last sentence of the first paragraph as follows:

This standard does not cover generator circuit breakers as these are covered in IEEE Std C37.013~~-1993~~ 1997.

4. Design tests

4.4 Dielectric withstand tests

4.4.7 Switching impulse voltage withstand tests

4.4.7.2 Condition of circuit breaker to be tested

Change the last sentence of the second paragraph as follows:

The conductors may be terminated in spheres or rings that have a diameter whose dimension in meters does not exceed an equivalent numerical value that is equal to the circuit breaker rated maximum voltage, in kV, ~~rms~~ divided by 655.

4.8 Short-circuit current interrupting tests

4.8.1 Test conditions

4.8.1.3 Current asymmetry

Replace Equation (1) with the following equation as follows:

Delete:

~~The defining equation for these curves is~~

$$\text{~~\%dc} = 100e^{-\alpha}\text{~~} \qquad \text{~~(1)~~}$$

~~where~~

$$\text{~~}\alpha = \frac{X/R}{2\pi f}\text{~~}$$

~~or~~

$$\frac{t}{\tau}$$

~~t = contact parting time~~

~~τ = time constant~~

Insert:

The defining equation for these curves is

$$\%dc = 100e^{-(t/\tau)} \qquad (1)$$

where:

t = contact parting time in seconds

τ = time constant = $\frac{X/R}{2\pi f} = \frac{L}{R}$ in seconds

with L = Inductance of the short circuit impedance at the fault location $= \frac{X}{2\pi f}$

and R = Resistance of the short circuit impedance at the fault location.

4.8.1.6 Short-line fault test conditions

Remove Table 1 listed under this paragraph. This table should be included under 4.8.3 titled "Test duties" which covers the tests and the definitions of the symbols used in this Table 1. (Subclause 4.8.1.6 covers only short-line fault test conditions and is not applicable to Table 1 which covers the series of test duties.)

4.8.1.7 Initial TRV test conditions

Change the fourth sentence of the first paragraph of page 20 as follows:

The peak line-side test voltage would be ~~(e + e_a)~~ (e_a + e) and the voltage should rise linearly to the value at time (T_L + t_d) ~~without a~~ with no intended time delay as shown in Figure 9.

4.8.3 Test duties

Insert Table 1 (from 4.8.1.6) under the heading "Test duties." Insert the following underlined modifications:

Table 1—Single-phase or three-phase test duties for short-circuit current tests

Test duty	Operating duty	Test voltage kV	Making I kA (pk)	I @ contact part kA	% asymmetry
1	Three Os	E		0.1 I	see 4.8.3.1
2	Three Os	E		0.3 I	see 4.8.3.1
3	Three Os	E		0.6 I	see 4.8.3.1
4	O-t-CO-t'-CO or (4a) and (4b)	E	F x I	I	< 20
4a	C-t'-C	E	F x I		
4b	O-t-O-t'-O	E		I	<20
5	Three Os	E		I_t see 4.8.3.3	>20
Single-phase tests					
6	O	0.58V		I	< 20
7	O	0.58V		I_t see 4.8.3.4	> 20
Single-phase short-line fault tests					
8	Three Os	0.58V		0.7I to 0.8I	< 20
9	Three Os	0.58V		0.9I to 0.95I	< 20
Short-time test					
10	Closed position		FxI	I for T seconds	

4.8.3.3 Test duty 5

Insert at the end of the second paragraph:

The required dc component must be attained at the time of contact separation in one phase during one of the interruptions. Test duty 5 is made with an asymmetrical current having a dc component, which is determined as described in 4.8.1.3. The required asymmetrical interrupting capability for three-phase short circuit current I_t is defined in 5.8.2.2 of IEEE Std C37.04-1999. It is made of a symmetrical current component equal to the rated short circuit current plus a dc component defined in percent of the peak value of the rated short circuit current ($\sqrt{2}$I).

4.8.3.4 Test duties 6 and 7

***Insert at the end of the third paragraph*:**

Test duty 7 is made with an asymmetrical current having a dc component, which is determined as described in 4.8.1.3, and a maximum arcing time corresponding to those specified in 4.8.1.4.2. The required asymmetrical interrupting capability for three-phase short circuit current I_t is defined in 5.8.2.2 of C37.04-1999. It is made of a symmetrical current component equal to the rated short circuit current plus a dc component defined in percent of the peak value of the rated short circuit current ($\sqrt{2}$I).

4.16 Design tests on pressurized components

4.16.1 Pressurized porcelain components

Change item a) as follows:

a) The combination of the short-circuit forces internall~~y of~~ to the circuit breaker plus the rated line pull withstand and a 40 m~~i~~/s (90 mi/h) wind velocity withstand; and

4.16.2 Pressurized non-ceramic components

4.16.2.3 External components

Change the second paragraph as follows:

These test shall be made in a prototype of each design of non-ceramic vessel, insulator, or tube having an internal or external gas pressure exceeding 208 kPa ~~(~~absolute pressure ~~)~~ or 104 kPa gauge (30 psi absolute or 15 psi~~g~~ gauge) and having an inside diameter exceeding 152 mm (6 in), after all coating, curing, and fabrication operations are completed.

Change item a) as follows:

a) The combination of the short-circuit forces internal to the circuit breaker plus the rated line pull withstand and a 40 m~~i~~/s (90 mi/h) wind velocity withstand; and

5. Production tests

5.4 Gas receiver tests

5.4.2 Porcelain components

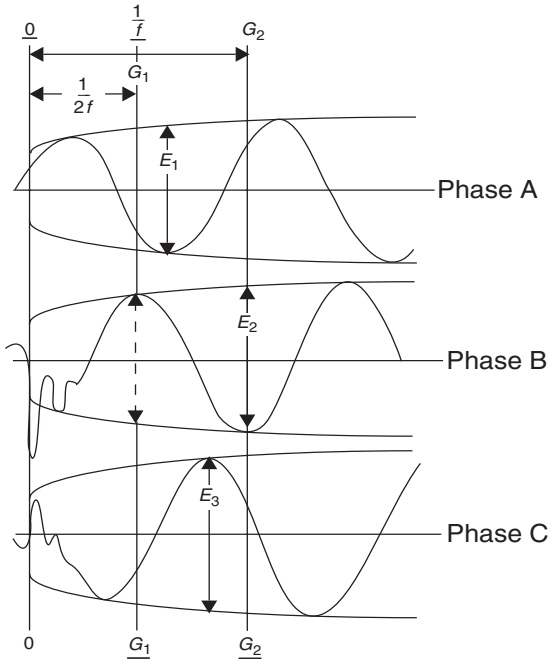
Change the first sentence of the second paragraph as follows:

All porcelain insulators, porcelain housings, or porcelain tubes having an internal or external gas pressure exceeding 208 kPa ~~(~~ absolute pressure ~~)~~ or 104 kPa gauge (30 psi absolute or 15 psi~~g~~ gauge) (with no limitation on size) shall individually withstand for five minutes a pressure equal to three times the maximum allowable working pressure after all glazing, firing, and grinding operations are completed.

7. Standard methods for determining the values of a sinusoidal current wave and a power-frequency recovery voltage

7.2 Power-frequency recovery voltage

Modify Figure 17 to include the dimension 00 - G_2G_2 as included below in the graph and other items underlined.



Phase A = first to open circuit

00 = instant of final arc extinction

$G_1\sout{G_2}\underline{G_1}$ = instant after interval $\frac{1}{2f}$ from 00

G_2G_2 = instant after interval $\frac{1}{f}$ from 00

$\frac{E_1}{2.828}$ = power frequency recovery voltage, Phase A

$\frac{E_2}{2.828}$ = power frequency recovery voltage, Phase B

$\frac{E_3}{2.828}$ = power frequency recovery voltage, Phase C

Average power frequency pole-unit recovery voltage

$$= \frac{(E_1/2.828 + E_2/2.828 + E_3/2.828)}{3}$$

$$\underline{\text{with } 2.828 = 2\sqrt{2}}$$

Power frequency phase-to-phase recovery voltage

$$= \sqrt{3}\left(\begin{array}{c}\text{Average power frequency}\\ \text{pole-unit recovery voltage}\end{array}\right)$$

Figure 17—Determination of the power-frequency pole unit recovery voltage

Annex A

(informative)

Records and reports of type tests for making, breaking, and short-time current performance

A.2 Information to be included in the reports

A.2.3 Rating assigned by manufacturer

Change item g) as follows:

g) Short-line fault surge impedance (Ω) and amplitude constant ~~factor)~~