

An American National Standard

IEEE Guide for Synthetic Fault Testing of AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

Sponsor

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of the
IEEE Power Engineering Society**

Secretariat

**Institute of Electrical and Electronics Engineers, Inc
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Foreword

(This Foreword is not a part of ANSI/IEEE C37.081-1981, IEEE Guide for Synthetic Fault Testing of AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.)

This is a new guide developed to provide a basis for synthetic testing of circuit breakers and to establish the criteria for testing to demonstrate the short circuit rating of circuit breakers.

The guide contains typical circuits for use in demonstrating interrupting capabilities, but these circuits are those in general use and they should not exclude the development or introduction of additional circuits.

The Standards Committee on Power Switchgear, C37, which reviewed and approved this Guide, had the following personnel at the time of approval:

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1. Introduction

1.1 General

To develop and test high-voltage circuit breakers to meet present and future system capabilities requires demonstration of performance at power levels in excess of the capacity of test laboratories or utility systems. Various means have been developed in the past to extend test capabilities such as two part testing or unit testing. A major extension of test capability results from the use of multiple source circuits.

ANSI C37.06-1979, [1]¹, establishes current and voltage requirements which may not be possible to achieve on direct tests. Multiple source circuits, generally identified as synthetic circuits, can achieve the required characteristics.

1.2 Scope and Purpose

This guide is intended to provide a basis for synthetic testing of circuit breakers (see ANSI/IEEE C37.04-1979 [2]) and to establish the criteria for testing to demonstrate the short-circuit current rating of circuit breakers on a single phase basis.

It is recognized that other test requirements exist (such as capacitor switching, or line dropping) but they will be reserved for future consideration.

The guide contains typical circuits for demonstrating interrupting capability. These circuits are those in general use and their inclusion should not exclude the development of additional circuits to demonstrate specific capabilities.

The purpose of this guide is to establish criteria for synthetic testing and for the proper evaluation of results. Such criteria will establish validity of the test method without imposing restraints on innovation and improvement of test circuitry.

¹Numbers in brackets correspond to those of the References, Section 3 of this guide.

2. Definitions

auxiliary circuit breaker: The circuit breaker used to disconnect the current circuit from direct connection with the test circuit breaker.

current circuit: That part of the synthetic test circuit from which the major part of the power frequency current is obtained.

current injection method: A synthetic test method in which the voltage circuit is applied to the test circuit breaker before power frequency current zero.

direct test: A test in which the applied voltage, current, and recovery voltage is obtained from a single power source, which may be comprised of generators, transformers, networks, or combinations of these.

distorted current: The current through the test circuit breaker which is influenced by the arc voltage of both the test and auxiliary circuit breakers during the high current interval (Fig 9).

injected current: The current which flows through the test circuit breaker from the voltage source of a current injection circuit when this circuit is applied to the test circuit breaker.

injected-current frequency: The frequency of the injected current.

injection time: The time with respect to the power frequency current zero when the voltage circuit is applied.

post-arc current: The current which flows through the arc gap of a circuit breaker immediately after current zero, and which has a substantially lower magnitude than the test current.

prospective current: The current that would flow if it were not influenced by the circuit breaker.

synthetic test: A test in which the major part of, or the total current, is obtained from one source (current circuit), and the major part of, or all of the transient recovery voltage from a separate source or sources (voltage circuit).

test circuit breaker: The circuit breaker under test.

voltage circuit: That part of the synthetic test circuit from which the major part of the test voltage is obtained.

voltage-injection method: A synthetic test method in which the voltage circuit is applied to the test circuit breaker after power frequency current zero.

3. References

[1] ANSI C37.06-1979, Preferred Ratings and Related Required Capabilities for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis (**Consolidated Edition**)²

[2] ANSI/IEEE C37.04-1979, Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis (**Consolidated Edition**, including Supplements C37.04a, C37.04b, and C37.04c)

[3] ANSI/IEEE C37.09-1979, Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis (**Consolidated Edition**)

²ANSI documents are available from The American National Standards Institute, 1430 Boardway, New York, N.Y. 10018.

4. Short-Circuit Current Interruption Process

4.1 Circuit Breaker Performance During Interruption; Basic Intervals

The Circuit breaker has two basic positions: closed and opened. In the closed position the circuit breaker conducts full current with negligible voltage drop across its contacts. In the open position it conducts negligible current but with full voltage across the contacts. This defines two main stresses, the current stress and the voltage stress, that are separated in time.

However, the main function of the circuit breaker is neither to conduct nor to isolate. It performs its main function in changing from one condition to the other, that is, the switching operation. If closer attention is paid to the voltage and current stresses during the interrupting test (Fig 1), three main intervals can be recognized.

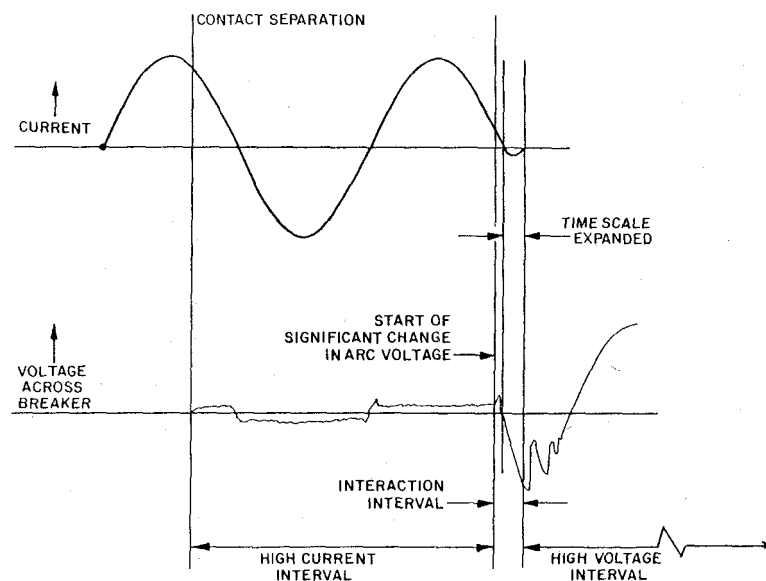


Figure 1— Three Basic Intervals of Interrupting Process

4.1.1 High-Current Interval

The high-current interval is the time from contact separation to the significant change in arc voltage preceding the interaction and high-voltage intervals.

4.1.2 Interaction Interval

The interaction interval is the time from the significant change in arc voltage prior to current zero to the time when the current including the post arc current, if any, ceases to flow through the test breaker.

4.1.3 High-Voltage Interval

The high-voltage interval is the time from the moment when the current including the post arc current, if any, ceases to flow through the test breaker to the end of the test.