

An American National Standard

IEEE Standard Enclosed Field Discharge Circuit Breakers for Rotating Electric Machinery

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of the
IEEE Power Engineering Society**

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National Electrical Manufacturers Association**

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Foreword

(This Foreword is not a part of ANSI/IEEE C37.18-1979, American National Standard Enclosed Field Discharge Circuit Breakers for Rotating Electric Machinery.)

This standard was first published in 1962 as IEEE Publication No 90 for trial use. It was also published as NEMA Std SG3-1965, Low-Voltage Power. After a period of industry use the material was reviewed and revised and published as USA Std 37.18-1968 (R1975), Requirements for Field Discharge Circuit Breakers for Rotating Electric Machinery, and USA Std C37.16a-1968, Supplement to USA Std C37.16-1963, Preferred Ratings and Related Requirements for Low-Voltage Power Circuit Breakers. This revision of the material, ANSI/IEEE C37.18-1979, which replaces ANSI C37.18-1968, was developed by the IEEE Working Group of the Low-Voltage Switchgear Devices Subcommittee.

The major revisions which have been made in updating this standard to reflect the changing state of the art are the addition of material concerned with solid-state sources of excitation and additional ratings. The preferred ratings and related requirements are still contained in Tables 7, 7A, and 14 of ANSI C37.16-1979, Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors (revision and consolidation of C37.15-1954 and C37.16-1970); although Section 7, Test Procedures, and Section 9, Application have been extensively revised to reflect present day requirements.

This publication represents standard practice in the United States relating to field discharge circuit breakers for use in field circuits of rotating electric machinery such as generators, motors, synchronous condensers, or exciters. American National Standards covering additional requirements are: ANSI C37.16-1979; Switchgear Assemblies, Including Metal-Enclosed Bus, ANSI/IEEE C37.20-1969, Definitions for Power Switchgear, ANSI C37.100-1972 (IEC 50-16) (IEC 277); Standard Techniques for High-Voltage Testing, IEEE Std 4-1978, (IEC 52).

Molded-case circuit breakers are covered by other standards but in some instances may be able to meet the requirements of this standard.

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

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CLAUSE	PAGE
1. Scope	1
2. Definitions.....	2
3. Service Conditions	2
4. Ratings	3
4.1 Rating Information	3
4.2 Rated Nominal Voltage Class	4
4.3 Rated Short-Time Voltage	4
4.4 Rated Maximum Interrupting Voltage	4
4.5 Rated Continuous Current.....	4
4.6 Short-Time Current Ratings.....	5
4.7 Interrupting Current Ratings	5
4.8 Rated Making Current of the Discharge Contacts	6
4.9 Rated Control Voltage	6
5. Functional Components	6
5.1 Nameplate(s)	7
5.2 Contact Position Indicator.....	7
5.3 Stored Energy Indicator	7
6. Temperature Limitations and Classification of Insulating Materials.....	7
6.1 Temperature Limits.....	7
6.2 Limits of Observable Temperature Rise	8
6.3 Classification of Insulating Materials	8
7. Insulation (Dielectric) Withstand Voltage Requirements	9
7.1 Field Discharge Circuit Breakers	9
7.2 Dielectric Test Procedures and Method of Voltage Measurement	9
8. Test Requirements.....	10
8.1 Classification of Tests	10
8.2 Design Tests.....	10
8.3 Production Tests.....	15
9. Application Guide	16
9.1 General	16
9.2 Functions Performed by a Field Discharge Circuit Breaker	17
9.3 Selection of Field Discharge Resistor	19
9.4 Selection of Field Discharge Circuit Breaker	20
10. Revision of American National Standards Referred to in this Standard.....	24

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IEEE Standard Enclosed Field Discharge Circuit Breakers for Rotating Electric Machinery

1. Scope

This standard applies to all low-voltage power-circuit breakers that are intended for use in field circuits of apparatus such as generators, motors, synchronous condensers, or exciters and embodying contacts for establishing field discharge circuits.

NOTE — In this standard, the use of the term “circuit breaker” shall be considered to mean “field discharge circuit breaker used in enclosures for rotating electric machinery.”

In performing their function of interrupting field circuits of rotating electric machinery, field discharge circuit breakers are subject to the following conditions not met within the interruption of ordinary direct-current power circuits.

- 1) In alternating-current machine field circuits, in addition to the problems usually encountered in switching highly inductive direct-current circuits, there is superimposed upon the voltage generated by the exciter, a voltage induced in the field windings by the transient current in the machine armature under alternating-current short-circuit conditions. These result in large pulsating currents in the field circuit as illustrated in Fig 1.
- 2) Due to the large amount of magnetic energy stored in the machine field circuit, the interruption of the circuit results in an unusually high transient voltage under alternating-current short-circuit conditions, unless special means are provided for dissipating the energy.
- 3) A discharge resistor must be connected across the terminals of the machine field by the discharge contacts of the circuit breaker just prior to disconnecting the field from its excitation source in order to provide for dissipation of the stored energy of the machine field and to minimize the transient voltage. The voltage across the field discharge circuit breaker main contacts following interruption of the excitation source current is illustrated in Fig 2.
- 4) In addition to the above conditions, there is the usual direct-current short-circuit condition wherein the field circuit may become short-circuited.

To cope with these unique conditions, this standard for field discharge breakers has been developed to establish the rating structure and test requirements not encountered in other ANSI Standards¹ which apply to other low-voltage circuit breakers.

The dielectric test values given in Table 7A, ANSI C37.16-1979, Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors, reflect the change in dielectric test requirements in ANSI C50.13-1977 Requirements for Cylindrical Rotor Synchronous Generators.

¹American National Standards are available from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

2. Definitions

The definitions of terms in this standard, or in other ANSI Standards referred to in this document, are not intended to embrace all legitimate meanings of the terms. They are applicable only to the subject treated in this standard.

For additional definitions, see ANSI C37.100-1972, Definitions for Power Switchgear and IEEE Std 421-1972, Criteria and Definitions for Excitation Systems for Synchronous Machines.

circuit breaker, field discharge: A circuit breaker having main contacts for energizing and deenergizing the field of a generator, motor, synchronous condenser, or rotating exciter, and having discharge contacts for short-circuiting the field through the discharge resistor at the instant preceding the opening of the circuit breaker main contacts. The discharge contacts also disconnect the field from the discharge resistor at the instant following the closing of the main contacts. For direct-current generator operation, the discharge contacts may open before the main contacts close.²

NOTE — When used in the main field circuit of an alternating or direct-current generator, motor, or synchronous condenser, the circuit breaker is designated as a main field discharge circuit breaker. When used in the field circuit of the rotating exciter of the main machine, the circuit breaker is designated as an exciter field discharge circuit breaker.

voltage class, rated nominal: The voltage to which operating and performance characteristics are referred.³

voltage, exciter-ceiling: The maximum voltage that may be attained by an exciter under specified conditions.³

voltage, rated maximum interrupting of main contacts: The maximum dc voltage, including voltage induced in the machine field by current in the machine armature, at which the field discharge circuit breaker main contacts are required to interrupt the excitation source current. The magnitude of the dc component of the total voltage across the main contacts is equal to the displacement of the axis.³ (See Fig 2 for illustration of the direct component of voltage under 3-phase fault conditions.)

voltage, rated short-time of main contacts: The highest dc voltage at which the circuit breaker main contacts shall be required to interrupt exciter short-circuit currents.³

3. Service Conditions

A circuit breaker conforming to this standard shall be suitable for operation up to and including all of its standard ratings, providing that:

- 1) The temperature of the air surrounding the circuit breaker is not below -5°C
NOTE — When properly applied in metal-enclosed power switchgear or individual enclosures, a circuit breaker will operate within the limits of ambient temperature of the air surrounding the enclosure as specified in ANSI/IEEE C37.20-1969, Switchgear Assemblies Including Metal-Enclosed Bus (1974 consolidated edition).
- 2) The altitude does not exceed 2000 m (6600 ft)
- 3) The relative humidity of the air surrounding the circuit breaker is such that there will be no condensation on the circuit breaker parts at any time
- 4) None of the service conditions listed in 9.4.8.2 prevail.

Whenever the service conditions depart from those defined in this section, consultation between the user and manufacturer is recommended. Some of the service conditions which may require additional attention are listed in 9.4.8.

²This definition differs from that appearing in ANSI C37.100-1972.

³At the time this standard was approved, there was no corresponding definition in ANSI C37.100-1972.

4. Ratings

4.1 Rating Information

The rating of field discharge circuit breakers is a designated limit of operating characteristics based upon service conditions in Section 3 and shall include the following as applicable:

- 1) Rated nominal voltage class
- 2) Rated short-time voltage of main contacts
- 3) Rated maximum interrupting voltage of main contacts
- 4) Rated continuous current of main contacts
- 5) Rated interrupting current of main contacts at rated short-time voltage
- 6) Rated interrupting current of main contacts at rated maximum interrupting voltage
- 7) Rated interrupting current of the discharge contacts at rated nominal voltage
- 8) Rated $\frac{1}{2}$ s short-time current of the main contacts
- 9) Rated 15 s short-time current of the discharge contacts
- 10) Rated $\frac{1}{2}$ s short-time current of the discharge contacts
- 11) Rated making current of the discharge contacts
- 12) Rated control voltage(s)

The designated ratings in ANSI C37.16-1979 are preferred but are not to be considered restrictive.

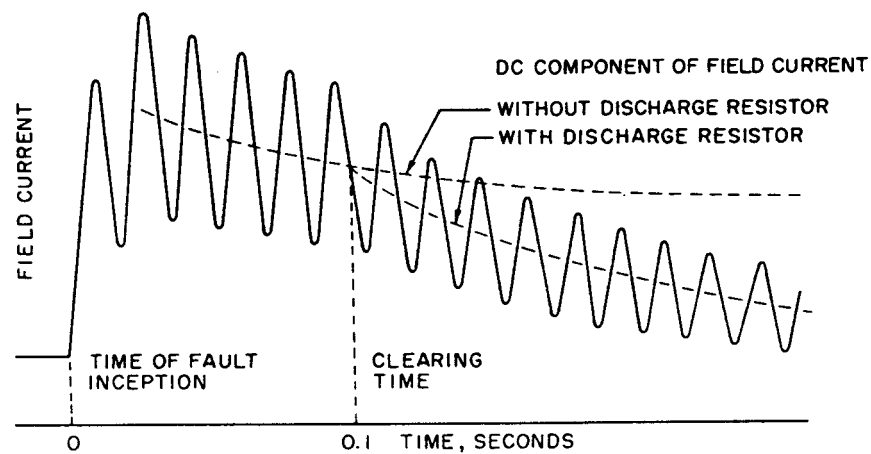


Figure 1 —Field Current with 3-Phase Fault on AC Machine Armature Circuit