

American National Standard

AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis— Preferred Ratings and Related Required Capabilities

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American National Standards Institute, Inc.

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FOREWORD (This foreword is not part of American National Standard C37.06-2000.)

This standard is a revision of ANSI C37.06-1997. It reflects small editorial changes needed to coordinate with the final wording contained in the defining standards ANSI/IEEE C37.04-1999 and ANSI/IEEE C37.09-1999. Some ratings have also been updated. Because this revision is primarily editorial in nature, this Foreword describes the substantive and editorial changes between this revision and the 1987 version. The format of the tables remains very much the same, except that some ratings, which had been given in the notes (sometimes on a different page from the table of preferred ratings), have been listed explicitly in the tables.

The transmission voltage classes of 121 kV, 169 kV, and 242 kV have been changed to 123 kV, 170 kV, and 245 kV respectively to complete the harmonization with IEC. This harmonization was begun when IEC adopted 550 kV and 800 kV, replacing 525 kV and 765 kV respectively.

Editorial revisions in Tables 1, 2, and 3:

The individual lines and columns have been identified with numbers for easy reference. The preferred ratings for transient recovery voltage maximum rated peak voltage E_2 value, have been moved from the notes to the table itself for tables 1 and 2. Similarly, the maximum permissible tripping delay value (Y) has been moved from the notes to the table itself for tables 1, 2, and 3. The maximum symmetrical interrupting capability is no longer listed explicitly in the tables since it is now numerically equal to the rated short-circuit current ($K=1.0$). Further, the short-time current rating is also equal to the short-circuit current rating, but it is included in the title of Col. 4 in the tables. The closing and latching current is now listed as a rating (it had been a related required capability), and the preferred ratings (kA, peak) have been calculated at 2.6 times the rated short-circuit current. This has been reduced from 2.7 times in the 1987 edition to promote harmonization with other international standards. (If expressed in terms of rms total current, momentary current, the equivalent value of the closing and latching current is 1.55 times the rated short-circuit current.)

Throughout this document, the term traditionally associated with the maximum value of transient or periodic wave form, "peak" is used.

Table 1—The major revision in the ratings for indoor circuit breakers is that the preferred values for the rated voltage range factor K have been set to 1.0 for all indoor circuit breaker ratings. The principal reason for this change is that the capabilities of today's circuit breaker designs are better described by the $K=1.0$ value. The user will note that an additional benefit to the $K=1.0$ system is that the number of notes in Table 1 are reduced by half.

This change in no way affects the ratings and capabilities of circuit breakers manufactured and tested to the ratings in the 1987 edition, which should continue to be applied in accordance with the 1987 standards. For convenience, Tables 1 and 1A of the 1987 edition are reproduced in this standard as tables A1 and A1A. During a transition period from the previous ratings basis ($K>1.0$) to the new ratings basis ($K=1.0$), the industry can still use the previous revision of the tables in applications where they are more convenient.

Rated time-to-peak (T_2) values for transient recovery voltage (TRV) have been specified for the first time. The values are those recommended by the IEEE Switchgear Committee's working group on transient recovery voltages, and are consistent with the values given in IEC 56 sub-clause 4.102.3. (Note: For the 1-cosine standard waveform envelope, the time-to-peak (T_2) value is equal to 1.137 times the t_3 parameter value listed in IEC 56.) The time-to-peak values (T_2) for (general purpose) circuit breakers, are based on assumption that there is sufficient circuit capacitance to limit the prospective TRV rise time to a value slower than that specified. Note 4 recognizes that there are applications, such as for transformer secondary fault protection, where the circuit capacitance may be much less, so that the prospective TRV rise time will be much faster than these preferred values. Based on recommendations from the IEEE

Switchgear Committee, NEMA has developed a trial-use guide for (definite purpose) circuit breakers capable of switching circuits characterized by fast TRV rise times: ANSI C37.06.1.

Lines have been added for the new 27 kV voltage class, and the 2000 revision adds the 63 kA rating at 15 kV. The preferred short-circuit ratings at 38 kV have been updated to reflect the interrupting capabilities of present circuit breaker technologies.

Table 1A—Cable charging current has replaced overhead line current because most indoor circuit breakers are connected to their load circuits by cables rather than overhead lines. Cables typically have much greater capacitance than overhead lines and, therefore, normally draw somewhat greater currents. Also, capacitance current ratings have been added for the 27 kV class, and the capacitance current ratings have been revised for the 38 kV class. The preferred capacitance current switching ratings in Table 1A were chosen to be consistent with present values in Table 2A for outdoor circuit breakers. The 63 kA rating has been added at 15 kV in the 2000 revision.

Table 2—Editorial revisions similar to those in Table 1 have been made. The TRV rated rate and rated delay columns (which had been blank) have been deleted because they are not applicable to the two parameter (1-cosine) TRV envelope for circuit breakers rated 72.5 kV and below.

Table 2A—Only minor editorial changes have been made.

Table 3—Editorial revisions similar to those in Table 1 have been made. In addition, in the 2000 revision, rated TRV rate has been revised to 2.0 kV/ μ sec to harmonize with IEC. Also in the 2000 revision, the list of preferred ratings has been expanded, and some historic lower ratings have been eliminated.

Table 3A—For back-to-back capacitor switching applications, preferred ratings for inrush current peak and frequency have been specified for 550 kV circuit breakers, and minor editorial changes have been made. Additional changes have been made in the 2000 revision to coordinate with Table 3 changes.

Table 4—The interrupter full wave withstand was removed in the 1997 version, but reinstated (as a note) in the 2000 revision. New ratings for 27 kV indoor breakers were added, and minor editorial changes were made in the 1997 revision. In 2000, creepage distances have been revised to coordinate with ANSI/IEEE C37.010, and 3 μ sec withstand requirements have been deleted.

Table 5—The interrupter full wave withstand is removed. A few minor editorial changes have been made.

Table 6—Figure 1 from the 1987 version was replaced by figures A1 and A2 in the 1997 version. As these TRV envelope curves have now been added to ANSI/IEEE C37.04, these figures have been eliminated in the 2000 revision.

Table 7—The table has been revised to reflect the characteristics of modern circuit breakers. Table 7 from the 1987 version became Table A2 in the 1997 version. Table 7 from the 1997 version had been Table 8 in the 1987 version.

Table 8—Editorial revisions only have been made. While control voltages are usually identified by their "nominal" values, the limits between which control voltage can range are specified in terms of the "Rated Range," that is, the minimum and maximum values. Table 8 from the 1997 version had been Table 9 in the 1987 version.

Table 9—The table has been revised to reflect the characteristics of modern circuit breakers. Table 9 from the 1997 version had been Table 10 in the 1987 version.

Appendix—For the convenience of those users who will be applying indoor circuit breakers with a rated voltage range factor K greater than 1.0, the 1987 revisions of Table 1 and Table 1A are included in the appendix as Table A1 and Table A1A, respectively.

Figures A1 and A2—(TRV envelope curves) were added in the 1997 version, but they have been eliminated in the 2000 revision as these curves are now in ANSI/IEEE C37.04.

Table A2—Formerly Table 7 of the 1987 revision. The switching surge factors rating table has been moved to the appendix (as Table A2) since the switching surge value is dependent upon the line parameters and surge arrester characteristics. When this table is published in C37.010, the table will be removed from the appendix.

Suggestions for the improvement of this standard are welcome. They should be sent to the Vice President, Engineering Department, National Electrical Manufacturers Association, 1300 N. 17th Street, Rosslyn, VA 22209.

This standard was processed and approved for submittal to ANSI by Accredited Standards Committee on Power Switchgear C37. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time of its approval, the C37 Committee had the following members:

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AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis—Preferred Ratings and Related Required Capabilities

1 Scope

This standard applies to all indoor and outdoor types of AC high-voltage circuit breakers rated above 1000 volts and rated on a symmetrical current basis.

2 Referenced standards

2.1 Referenced American National Standards

This standard is intended to be used in conjunction with the following American National Standards. When the referenced standards are superseded by a revision approved by the American National Standards Institute, Inc., the revisions shall apply:

ANSI C84.1-1995, *Voltage Ratings (60-Hz)—Electrical Power Systems and Equipment*

ANSI/IEEE C37.010-1999, *Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis*

ANSI/IEEE C37.011-1994, *Application Guide for Transient Recovery Voltage for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis*

ANSI/IEEE C37.012-1979 (R1988), *Application Guide for Capacitance Current Switching for AC High-Voltage Circuit Breakers Rated on Symmetrical Current Basis*

ANSI/IEEE C37.100-1992, *Definitions for Power Switchgear*

ANSI/IEEE C37.04-1999, *Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis*

ANSI C37.06.1-2000, *High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis Designated "Definite Purpose for Fast Transient Recovery Voltage Rise Times"*

ANSI/IEEE C37.09-1999, *Test Procedures for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis*

ANSI/IEEE 32-1972 (R1997), *IEEE Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices*

ANSI/NEMA MG1-1998, *Motors and Generators*

2.2 Other referenced standards

ANSI/IEEE Std. 4-1978, *IEEE Standard Techniques for High-Voltage Testing* (Note, the 1978 version is specifically referenced in this standard because the latest revision (1995) does not include critical test techniques needed for circuit breaker testing. When ANSI/IEEE Std. 4 is suitably revised, it will be officially recognized in ANSI C37.06).