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American Standards for Alternating-Current Power Circuit Breakers

Approved May 16, 1945
American Standards Association

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Electrical Standards Committee



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American Standard

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Alternating-Current Power Circuit Breakers C37.4-1945

Methods for Determining the Rms Value of a Sinusoidal Current Wave and a Normal-Frequency Recovery Voltage C37.5-1945

Schedule of Preferred Ratings for Power Circuit Breakers C37.6-1945

Operating Duty (Duty Cycle) for Standard and Reclosing Service C37.7-1945

Rated Control Voltages C37.8-1945

Test Code for Power Circuit Breakers C37.9-1945

Foreword

This publication represents standard practices in the United States relating to alternating-current power circuit breakers. It contains data secured from many sources—notably the established standards of the American Institute of Electrical Engineers and the National Electrical Manufacturers Association. It also includes data prepared by the Association of Edison Illuminating Companies.

This publication combines, in one reference work, information relating to the terms and conditions upon which the rating and behavior of alternating-current power circuit breakers are based. The publication is divided into six parts. The main part consists of a definite Standard, C37.4-1945, for alternating-current power circuit breakers, which covers definitions and ratings of apparatus coming within the scope of this work. The remainder consists of supplementary standards, one of which, C37.9-1945, covers the procedure for testing circuit breakers. The Schedule of Preferred Ratings for Indoor and Outdoor Circuit Breakers, C37.6-1945, is included.

These standards were published in proposed form in January, 1941, for trial use and study. On the basis of suggestions received during this trial period, principally from the Protective Devices Committee of the American Institute of Electrical Engineers, the proposed standards were revised prior to approval in their present form. Many of the provisions of C37.4-1945 and C37.5-1945 were taken directly from Alternating-Current Power Circuit Breakers, AIEE 19-1943.

The organizations represented on the Sectional Committee on Power Switchgear, C37, which prepared this standard, and the names of their representatives, are as follows:

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(Foreword continued following page)

Foreword (*Continued*)

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Contents

	PAGE
Alternating-Current Power Circuit Breakers, C37.4-1945	11
4-1. Scope	11
4-2. Service Conditions	11
4-3. Definitions, General	11
4-4. Definitions, Construction	13
4-5. Qualifying Terms	14
4-6. Rating	15
4-7. Heating	18
4-8. Dielectric Tests	20
4-9. Name-Plate Markings	21
Method for Determining the Rms Value of a Sinusoidal Current Wave and a Normal-Frequency Recovery Voltage, C37.5-1945	23
5-1. Current Waves	23
5-2. Normal-Frequency Recovery Voltage	27
Schedule of Preferred Ratings for Power Circuit Breakers, C37.6-1945 ...	28
Operating Duty (Duty Cycle) for Standard and Reclosing Service Applicable to Oil Circuit Breakers Only, C37.7-1945	32
Rated Control Voltages, C37.8-1945	33
Test Code for Power Circuit Breakers, C37.9-1945	35
Introduction	35
9-1. General	35
9-1.1 General Considerations and Scope	35
9-1.2 Test Methods	35
9-2. Effects of Laboratory Characteristics and Testing Procedure.....	37
9-2.1 Generator Characteristics and Their Effects on Circuit-Breaker Tests..	37
9-2.2 Transient Recovery Voltages and Transient Recovery Voltage Rates..	39
9-2.3 Comparison of Types of Operations and Tripping Schemes Upon Circuit-Breaker Performance	44
9-2.4 Use of Current Transformers Versus Shunts for Short-Circuit Measurements	45
Bibliography	46
Index	49

Tables

	PAGE
Alternating-Current Power Circuit Breakers, C37.4-1945	
Table 1. Classification of Insulating Materials	19
Table 2. Standard Test Voltages, Power Circuit Breakers	20

(Continued following page)

Tables (Continued)

	PAGE
Schedule of Preferred Ratings for Power Circuit Breakers, C37.6-1945	
Table 1. Indoor Oil Power Circuit Breakers	28
Table 2. Indoor Oilless Power Circuit Breakers	29
Table 3. Outdoor Oil Power Circuit Breakers	30
Table 4. Outdoor Oilless and Low Oil Content Power Circuit Breakers.....	31
 Operating Duty (Duty Cycle) for Standard and Reclosing Service	
Applicable to Oil Circuit Breakers Only, C37.7-1945	
Table 1. Percentages for Determining the Interrupting Rating for Oil-Tight Circuit Breakers at Various Operating Duties	32
Table 2. Percentages for Determining the Interrupting Rating for Non-Oil- Tight Oil Circuit Breakers at Various Operating Duties	32
 Rated Control Voltages, C37.8-1945	33

Figures

	PAGE
Method for Determining the Rms Value of a Sinusoidal Current Wave and a Normal-Frequency Recovery Voltage, C37.5-1945	
Fig. 1 Symmetrical Sinusoidal Wave	23
Fig. 2 Asymmetrical Sinusoidal Wave	23
Fig. 3 Chart for Determining the Rms Value of an Asymmetrical Sine Wave...	24
Fig. 4 A Scale for Measuring the Rms Value of an Asymmetrical Sine Wave...	25
Fig. 5 A Curve for Determining the Rms Value of a Single Loop of a Displaced Sine Wave	26
Fig. 6 Determination of Normal-Frequency Recovery Voltage	27
 Test Code for Power Circuit Breakers, C37.9-1945	
Fig. 1 Comparison of Decrement Curves, 3-Phase Symmetrical Short Circuit, 100-Percent Value Based on Projection of Envelope to Zero Time....	37
Fig. 2 Comparison of the Magnitude of Transient Recovery-Voltage Condi- tions for Symmetrical and Displaced Current Waves.....	38
Fig. 3A Comparison of Effect of Asymmetry Factor on Instantaneous Value of Normal-Frequency Recovery Voltage with 0.50 Power Factor and Interruption on Current Zero Following Large Loop and Small Loop..	38
Fig. 3B Asymmetry Factors for Displaced Current Waves and Various Power Factors	38
Fig. 4 Transient Recovery Voltage Rates	41
Fig. 5 Generalized Circuit for Calculation of Circuit Transient Recovery Voltage	41
Fig. 6 Equivalent Circuit of Fig. 5	41

American Standard

Alternating-Current Power Circuit Breakers

C37.4-1945

4-1 Scope

4-1.1 These standards apply to all indoor and outdoor types of alternating-current power circuit breakers rated in excess of 600 volts.

4-2 Service Conditions

4-2.1 Usual Service Conditions. Alternating-current power circuit breakers conforming to these standards shall be suitable for operating at their standard ratings:

- (a) Where the temperature of the cooling medium does not exceed 40 C if the circuit breakers have copper to copper contacts or equivalent;
- (b) Where the temperature of the cooling medium does not exceed 55 C if the circuit breakers have all contacts silver surfaced or equivalent, and in addition have all conducting joints, including terminal connections, either
 - (1) soldered or silver surfaced and separately held mechanically, or
 - (2) brazed, welded or silver soldered, and provided that such operation does not result in total temperatures in excess of 90 C for Class O, 105 C for Class A, and 125 C for Class B insulations;
- (c) Where the altitude does not exceed 3,300 feet (1,000 meters).

4-2.2 Unusual Service Conditions. The use of apparatus in cooling media having temperatures in excess of those in 4-2.1, or at altitudes greater than 3,300 feet (1,000 meters) shall be considered as special.

4-2.2.1 Voltage and Current Ratings. For application at altitudes greater than 3,300 feet (1,000 meters), it is recommended that the standard voltage and continuous-current ratings of the apparatus should be multiplied by the following factors

to obtain the voltage and current at which the application may be made:

Altitude in Feet	Correction Factors	
	Voltage	Current
3300 (1000 meters)	1.00	1.000
4000 (1200 meters)	0.98	0.996
5000 (1500 meters)	0.95	0.990
10000 (3000 meters)	0.80	0.960

4-2.3 Conditions Affecting Construction or Protecting Features. There are further unusual conditions which, where they exist, should receive special consideration. Such conditions should be brought to the attention of those responsible for the application, manufacture, and operation of the equipment. Apparatus for use in such cases may require special construction or protection. Among such unusual conditions are:

- (a) Exposure to damaging fumes or vapors, excessive or abrasive dust, explosive mixtures of dust or gases, steam, salt spray, excessive moisture, or dripping water, etc;
- (b) Exposure to abnormal vibration, shocks, or tilting;
- (c) Exposure to excessively high or low temperatures;
- (d) Exposure to unusual transportation or storage conditions;
- (e) Unusual space limitations;
- (f) Unusual operating duty, frequency of operation, difficulty of maintenance, etc.

4-3 Definitions, General

Definitions as given herein apply specifically to the apparatus treated in this American standard. For additional definitions, see American Standard Definitions of Electrical Terms, C42-1941. The 3-part numbers in parentheses preceding the titles of some of the definitions included in this standard indicate the number of the corresponding definitions in C42. Certain of the definitions which do not carry the 3-part number are differently

worded from the corresponding definition in C42. These are being submitted for consideration for inclusion in the next revision of C42.

4-3.1 (20.15.005) Circuit Breaker. A circuit breaker is a device for interrupting a circuit between separable contacts under normal or abnormal conditions.* Ordinarily circuit breakers are required to operate only infrequently, although some classes of breakers are suitable for frequent operation.

4-3.2 (20.15.010) Oil Circuit Breaker. An oil circuit breaker is a circuit breaker in which the interruption occurs in oil.

4-3.3 (20.15.015) Air Circuit Breaker. An air circuit breaker is a circuit breaker in which the interruption occurs in air.

4-3.4 Power Circuit Breaker. For the purpose of this standard, power circuit breakers comprise alternating-current circuit breakers as follows:

- (a) Oil circuit breakers rated in excess of 600 volts;
- (b) Air circuit breakers rated in excess of 600 volts;
- (c) Circuit breakers using liquids other than oil and rated in excess of 600 volts.

4-3.5 (20.05.171) Operating Voltage. The operating voltage of a circuit breaker is the rms voltage of the system on which it is to be operated.

4-3.6 Recovery Voltage. Recovery voltage is the voltage which occurs across the terminals of a circuit-interrupting device upon interruption of the current.

4-3.6.1 Normal-Frequency Recovery Voltage. The normal-frequency recovery voltage is the normal-frequency rms voltage which occurs across the terminals of a circuit-interrupting device after the interruption of the current and after high-frequency transients have subsided. For determination of the normal-frequency recovery voltage, see 5-2 of American Standard Methods for Determining the Rms Value of a Sinusoidal Current Wave and a Normal-Frequency Recovery Voltage, C37.5-1945, page 27.

**Normal* indicates the interruption of current not in excess of the rated continuous current of the circuit breaker. *Abnormal* indicates the interruption of current, such as short circuits, in excess of such rated continuous current. In application, circuit breakers are selected whose rated interrupting current is as great, or greater, than the maximum current which they may be called upon to interrupt.

4-3.6.2 Transient Recovery Voltage. The transient recovery voltage is the voltage transient which occurs across the terminals of a circuit-interrupting device upon interruption of the current. This transient usually exists for only a fraction of a cycle. In a multipole interrupting device, the term is usually applied to the voltage across the first pole to clear.

4-3.6.2a Circuit Transient Recovery Voltage. The circuit transient recovery voltage is the transient recovery voltage characterizing the circuit and obtained with 100-percent normal-frequency recovery voltage, a symmetrical current, and no modifying effect of the breaker. This voltage indicates the inherent severity of the circuit with respect to recovery-voltage phenomena.

4-3.6.2b Modified Circuit Transient Recovery Voltage. The modified circuit transient recovery voltage is the circuit transient recovery voltage modified in accordance with the normal-frequency recovery voltage and the asymmetry of the current wave obtained on a particular interruption. This voltage indicates the severity of the particular interruption with respect to recovery-voltage phenomena.

4-3.6.2c Test Transient Recovery Voltage. The test transient recovery voltage is the transient recovery voltage which actually occurs across the terminals of a circuit-interrupting device on a particular interruption. This is the modified circuit transient recovery voltage with whatever distortion may be introduced by the circuit-interrupting device.

4-3.6.3 Transient Recovery Voltage Rate. The transient recovery voltage rate is the rate at which voltage rises across the terminals of a circuit-interrupting device upon interruption of the current. It is usually determined by dividing the voltage at one of the crests of the transient recovery voltage by the time from current zero to that crest. In case no definite crest exists the rate is taken to some arbitrarily chosen value usually selected as a certain percentage of the crest value of the normal-frequency recovery voltage.

4-3.6.3a The transient recovery rate may be either a circuit transient recovery voltage rate, a modified circuit transient recovery voltage rate, or a test transient recovery voltage rate according to the type of transient from which it is obtained.

4-3.6.3b When giving test transient recovery voltage rates, the method of determining the

time of current zero should be definitely stated. For determination of transient recovery voltage rates, see 9-2.2, page 39, American Standard Test Code for Power Circuit Breakers, C37.9-1945.

4-4 Definitions, Construction

4-4.1 (20.10.285) Arcing Contacts. Arcing contacts are the contacts on which the arc is drawn after the main contacts of a circuit breaker have parted. (See 4-4.16.1 and 4-4.16.2 for definitions of stationary and moving contacts)

4-4.2 (20.10.080) Auxiliary Switch. An auxiliary switch is a switch actuated by some main device, such as a circuit breaker, for signalling, interlocking, or other purpose.

NOTE: As applied to circuit breakers, an auxiliary switch is designated as "a" (usually shown on drawings as normally open) if it is closed when the circuit breaker is closed, or as "b" (usually shown on drawings as normally closed) if it is closed when the circuit breaker is open.

4-4.3 (20.15.210) Break. The break of a circuit-opening device is the minimum distance between the stationary and movable contacts when these contacts are in the open position.

4-4.3.1 The length of a single break is as defined above.

4-4.3.2 The length of a multiple break (breaks in series) is the sum of the several breaks.

4-4.4 Bushing. A bushing is an insulating structure including a central conductor, or providing a central passage for a conductor, with provision for mounting on a barrier, conducting or otherwise, for the purpose of insulating the conductor from the barrier and conducting current from one side of the barrier to the other.

4-4.5 (20.15.179) Circuit-Breaker Mechanism. A circuit-breaker mechanism is an assembly of levers and other parts which actuates the moving contacts of the circuit breaker.

4-4.5.1 Pole-Unit Mechanism. A pole-unit mechanism is an assembly which actuates the moving contacts of a pole unit.

4-4.5.2 Operating Mechanism. An operating mechanism is a power-operated or manual mechanism by which the contacts of all poles of a circuit breaker are actuated.

4-4.5.3 (20.15.184) Tripping Mechanism. A tripping mechanism is an electrically or mechanically operated device which releases the holding means and permits the contacts of the circuit breaker to open.

4-4.6 (20.15.180) Closing Coil (of a Circuit Breaker). A closing coil of a circuit breaker is a coil used in the electromagnet which supplies power for closing a circuit breaker.

4-4.7 (20.25.090) Closing Relay. A closing relay is a form of auxiliary relay used with an electrically operated device to control the closing and opening of the operating circuit of the device so that the main operating current does not pass through the control switch or other initiating device.

4-4.8 Conducting Parts. Conducting parts of apparatus are those parts designed to carry current, or which are conductively connected thereto.

4-4.9 (20.10.245) Live Parts. See Live Parts, 4-4.15.

4-4.10 (35.15.060) Grounded Parts. See Grounded Parts, 4-4.13.

4-4.11 Contact. A contact is a conducting part which co-acts with another conducting part to complete or to interrupt a circuit.

4-4.12 (20.10.295) Contact Surfaces. Contact surfaces are the surfaces of contacts which meet and through which the current is transferred when the contacts are closed.

4-4.13 (35.15.060) Grounded Parts. Grounded parts are those parts which are so connected that they are intentionally grounded.

4-4.14 (25.95.060) Interlock*. An interlock is a device actuated by the operation of some other device with which it is directly associated, to govern succeeding operations of the same or allied devices.

4-4.15 (20.10.245) Live Parts. Live parts are those parts which are electrically connected to points of potential different from that of the earth.

4-4.16 (20.10.280) Main Contacts. A main contact is a conducting part designed to be united by pressure to another conducting part for the purpose of carrying current. The contacts of a circuit breaker are composed of the surfaces brought together or separated by the operation of the breaker mechanism.

4-4.16.1 (20.10.270) Stationary Contact-Member. A stationary contact-member is a con-

*Interlocks may be either electrical or mechanical.

ducting part which bears a contact surface which remains substantially stationary.

4-4.16.2 (20.10.275) Moving Contact-Member. A moving contact-member is a conducting part which bears a contact surface which moves to and from the stationary contact.

4-4.17 (20.15.185) Trip Coil (of a Circuit Breaker). A trip coil of a circuit breaker is a coil used in the electromagnet which supplies power for tripping a circuit breaker.

4-5 Qualifying Terms

4-5.1 (20.15.095) Automatic Tripping (Automatic Opening). Automatic tripping is the opening of a circuit breaker under predetermined or other conditions without the intervention of an operator.

4-5.1.1 Directional Tripping. Directional tripping signifies the tripping of a circuit breaker dependent upon the direction of power in the main circuit.

4-5.1.2 (20.15.125) Over-Voltage Tripping. Over-voltage tripping signifies the tripping of a circuit breaker from a trip coil connected in shunt to the main circuit and responsive to an increase in the main circuit voltage.

4-5.1.3 (20.15.100) Series Over-Current Tripping. Series over-current tripping signifies the tripping of a circuit breaker from a trip coil in series with the main circuit, responsive to an increase in the main circuit current.

4-5.1.4 (20.15.130) Series Under-Current Tripping. Series under-current tripping signifies the tripping of a circuit breaker from a trip coil in series with the main circuit, responsive to a decrease in the main-circuit current.

4-5.1.5 (20.15.110) Shunt Tripping. Shunt tripping signifies the tripping of a circuit breaker by a trip coil energized from the same or a separate shunt circuit or source of power, the trip-coil circuit being closed through a relay, switch, or other means.

4-5.1.6 (20.15.105) Transformer Over-Current Tripping. Transformer over-current tripping signifies the tripping of a circuit breaker from a trip coil in series with the secondary winding of a current transformer whose primary winding is in series with the main circuit, thus making the trip coil responsive to an increase in the main-circuit current.

4-5.1.7 (20.15.135) Transformer Under-Current Tripping. Transformer under-current tripping signifies the tripping of a circuit breaker by a trip coil in series with the secondary winding of a current transformer whose primary winding is in series with the main circuit, thus making the trip coil responsive to a decrease in the main-circuit current.

4-5.1.8 (20.15.120) Under-Voltage Tripping. Under-voltage tripping signifies the tripping of a circuit breaker from a trip coil connected in shunt to the main circuit and responsive to a decrease in the main-circuit voltage.

4-5.2 (20.25.380) Definite Time. Definite time is a qualifying term indicating that there is purposely introduced a delay in action, which delay remains substantially constant regardless of the magnitude of the quantity that causes the action.

4-5.3 (20.25.400) Instantaneous. Instantaneous is a qualifying term indicating that no delay is purposely introduced in the action of the device.

4-5.4 (20.25.405) Inverse Time. Inverse time is a qualifying term indicating that there is purposely introduced a delayed action, which delay decreases as the operating force increases.

4-5.5 (20.15.140) Non-Automatic Tripping. Non-automatic tripping is the opening of a circuit breaker only in response to an act of an operator.

4-5.6 (20.10.450) Operation.* Operation, as applied to a circuit breaker, is the method provided for its normal functioning.

4-5.6.1 (20.10.465) Direct Operation.* Direct operation of a mechanically operated circuit breaker is operation by means of a mechanism connected directly to the main operating shaft, or an extension of it.

4-5.6.2 (20.10.461) Electrical Operation.* Electrical operation of a circuit breaker is power operation by electricity.

4-5.6.3 (20.10.475) Group Operation.* Group operation of a multipole circuit breaker is the operation of all poles by means of 1 operating mechanism.

4-5.6.4 (20.10.470) Indirect Operation.* Indirect operation of a circuit breaker is operation

*The above definitions relate to method of *operation* and should not be confused with method of *control*. For instance, electrical *operation* may involve automatic or non-automatic (hand or manual) *control*.

by means of an operating mechanism connected to the main operating shaft, or an extension of it, through off-set linkages and bearings.

4-5.6.5 (20.10.462) Manual Operation.* Manual operation of a circuit breaker is operation by hand without using any other source of power.

4-5.6.6 (20.10.463) Power Operation.* Power operation of a circuit breaker is operation by power (electric, pneumatic, etc) other than by hand.

4-5.6.7 Remote Controlled Operation.* Remote controlled operation of a circuit breaker is operation by means of an operating mechanism controlled from a distant point either manually or electrically, or both, or by other means.

4-5.7 Operating Time

4-5.7.1 (20.15.075) Closing Time.† The closing time of a circuit breaker is the interval between the making of contact at the closing switch and the contacting of the arcing contacts of the circuit breaker at rated control voltage.

4-5.7.2 (20.15.080) Opening Time. The opening time of a circuit breaker is the interval existing between the energizing of the trip coil at rated voltage and the parting of the arcing contacts of the circuit breaker.

4-5.7.3 (20.15.090) Arcing Time. The arcing time of a circuit breaker is the interval between the parting of the arcing contacts and the extinction of the arc.

4-5.7.4 (20.15.085) Interrupting Time.‡ The interrupting time of a circuit breaker is the interval existing between the energizing of the trip coil at rated voltage and the interruption of the circuit.

4-5.7.5 (20.15.076) Reclosing Time. The reclosing time of a circuit breaker is the interval between the energizing of the trip coil (the breaker being in the closed position) and the contacting of the arcing contacts on the reclosing stroke, with rated control voltage applied.

*The above definitions relate to method of *operation* and should not be confused with method of *control*. For instance, electrical *operation* may involve automatic or non-automatic (hand or manual) *control*.

†Where a closing relay is used with an electrically operated circuit breaker, the closing time includes the time consumed in the operation of the closing relay.

‡This is the summation of the opening time and the arcing time. If the tripping current of the circuit breaker is large enough to require the use of an individual auxiliary relay, the interrupting time includes the time consumed in the operation of such auxiliary relay.

4-5.8 Throw

4-5.8.1 (20.15.025) Double-Throw Circuit Breaker. A double-throw circuit breaker is a circuit breaker by means of which a change in the circuit connections can be obtained by closing either of 2 sets of contacts.

4-5.8.2 (20.15.020) Single-Throw Circuit Breaker. A single-throw circuit breaker is a circuit breaker by means of which the circuit can be closed or opened by moving 1 set of contacts only.

4-5.9 Trip Free. A circuit breaker is trip free when the tripping mechanism can trip the breaker, even though the normal closing action is applied.

4-5.9.1 (20.15.145) Mechanically Trip Free. A circuit breaker is mechanically trip free when the tripping mechanism can trip it, even though: (1) in a manually operated circuit breaker, the operating lever is held in the closed position; or, (2) in an electrically operated circuit breaker, the operating mechanism is held in the closing position either electrically or by means of an emergency closing lever.

4-5.9.2 Manually Trip Free. See Mechanically Trip Free, 4-5.9.1, for a manually operated circuit breaker.

4-5.9.3 (20.15.150) Electrically Trip Free. An electrically operated circuit breaker is electrically trip free when the tripping mechanism can trip it, even though the closing control circuit is energized, and the closing mechanism will not reclose it after tripping until the closing control circuit is opened and again closed. However, the breaker may be held closed by the emergency operating lever, unless it is also mechanically trip free.

4-5.9.4 (20.15.155) Trip Free in Any Position. A circuit breaker is trip free in any position when it is trip free at any part of the closing operation. If the tripping circuit is completed through an auxiliary switch, electrical tripping will not take place until such auxiliary switch is closed.

4-6 Rating

4-6.1 Rating. The rating of a machine, apparatus, or device, is a designated limit of operating characteristics based upon definite conditions. The rating of a circuit breaker shall include the following items:

- (a) Rated voltage
- (b) Rated impulse withstand voltage
- (c) Rated frequency

4-6.1 Rating (*Continued*)

- (d) Rated continuous current
- (e) Rated short-time currents
- (f) Rated making current
- (g) Rated latching current
- (h) Rated interrupting current (Rated interrupting capacity)
- (i) Rated interrupting kva

4-6.2 Rated Voltage. The rated voltage of a circuit breaker is the highest rms voltage at which it is designed to operate.

4-6.3 Standard Voltage Ratings. The standard voltage ratings of circuit breakers shall be:

750	23,000	138,000
2,500	34,500	161,000
5,000	46,000	230,000
7,500	69,000	287,500
15,000	115,000	345,000

The above values are present industry standard ratings, and are now being studied by EEI-NEMA* Joint Committee on Preferred Voltage Ratings for A-C Systems and Equipment. A tolerance not exceeding 5 percent is recognized for circuit over-voltage conditions, except for ratings 15,000 volts and below, which are maximum.

4-6.4 Rated Frequency. The rated frequency of a circuit breaker is the frequency of the circuit for which it is designed.

4-6.5 Standard Frequency Ratings. Standard ratings of circuit breakers are understood to be at 60 cycles unless otherwise specified.

4-6.6 Ratings for 25 Cycles. Circuit breakers for 25-cycle service shall be standard 60-cycle equipment, given its corresponding rating at 25 cycles. Applications of oilless circuit breakers on 25-cycle systems should receive special consideration.

4-6.7 Rated Continuous Current. The rated continuous current of a circuit breaker is the designated limit of current in rms amperes which it will carry continuously without exceeding the limit of observable temperature rise. For tables of standard continuous current ratings, see American Standard Schedule of Preferred Ratings for Power Circuit Breakers, C37.6-1945, pages 28-31.

4-6.8 Rated Short-Time Current. The rated

short-time current of a circuit breaker is the highest current including the d-c component that the breaker shall be required to carry without injury for specified short-time intervals. The ratings recognize the limitations imposed by both thermal and electromagnetic effects. The standards for short-time ratings shall be the following.

4-6.8.1 Rated Momentary Current. The rated momentary current of a circuit breaker is the maximum rms total current which the breaker shall be required to carry for any time, however small, up to 1 second. The current is the rms value, including the d-c component, during the maximum cycle as determined from the envelope of the current wave. For determination of current the method shown in American Standard Methods for Determining the Rms Value of a Sinusoidal Current Wave and a Normal-Frequency Recovery Voltage, C37.5-1945, page 23, shall be used.

4-6.8.2 Rated 5-Second Current. The rated 5-second current of a circuit breaker is the rms total current including the d-c component which the breaker shall be required to carry for 5 seconds. For practical purposes, this current is measured at the end of the first second. For tables of short-time current ratings see schedule of preferred ratings, C37.6-1945, pages 28-31.

4-6.9 Rated Making Current. The rated making current of a power-operated circuit breaker is the maximum rms current, including the d-c component, against which the breaker shall be capable of closing without welding of contacts or undue damage to the breaker or contacts, and providing the breaker be immediately opened without purposely delayed action. The values for these ratings have not yet been established. The control voltage at the terminals of the closing mechanism, in the case of electrically operated breakers, is a factor in the determination of these values.

4-6.10 Rated Latching Current. The rated latching current of a power-operated circuit breaker is the maximum rms current, including the d-c component, against which the breaker shall be capable of closing and latching. The values for these ratings have not yet been established. The control voltage at the terminals of the closing mechanism, in the case of electrically operated breakers, is a factor in the determination of these values.

4-6.11 Rated Interrupting Current (Rated Interrupting Capacity). The rated interrupting

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current of a circuit breaker is the highest rms current at a specified operating voltage, which the breaker shall be required to interrupt under the operating duty specified, and with a normal-frequency recovery voltage equal to the specified operating voltage. Where limited by testing equipment, the maximum tolerance for normal-frequency recovery voltage shall be 15 percent of the specified operating voltage. The current is the rms value, including the d-c component, at the instant of contact separation as determined from the envelope of the current wave. For determination of current and normal-frequency recovery voltage, the method shown in C-37.5-1945, page 27, shall be used. For tables of standard ampere interrupting ratings, see schedule of preferred ratings, C37.6-1945, pages 28-31.

4-6.11.1 Calculation of Rated Interrupting Current. To obtain the rated interrupting current of a breaker at an operating voltage less than the rated voltage of the circuit breaker, the following formula should be used:

$$\text{Amperes at operating voltage} = \text{amperes at rated voltage} \times \frac{\text{rated voltage}}{\text{operating voltage}}$$

If the value so calculated exceeds that of the rated maximum interrupting current, then the latter rating must be used as the interrupting rating of the breaker.

4-6.12 Rated Maximum Interrupting Current. The rated maximum interrupting current of a circuit breaker is a limiting value of rated interrupting current (see 4-6.11) beyond which the rated interrupting current shall not be increased even for operating voltages below the value of minimum operating voltage given in Tables 1, 2, 3, and 4, pages 28-31, of C-37.6-1945. For tables of standard maximum interrupting current ratings, see schedule of preferred rating C37.6-1945, pages 28-31.

4-6.13 Rated Interrupting Kva. The rated interrupting kva at a specified voltage is the product of rated interrupting current, voltage, and proper phase factor, *ie*, 1.73 for 3-phase; 2 for 2-phase; 1 for single-phase. For tables of standard interrupting kva ratings, see schedule of preferred ratings, C37.6-1945, pages 28-31.

4-6.14 Rated Interrupting Time. The rated interrupting time of a circuit breaker is the specified interval between the energizing of the trip coil at rated voltage and the interruption of the main circuit.

4-6.15 Standard Interrupting Rating. The standard interrupting rating shall be based on the standard operating duty. For tables of standard interrupting ratings see schedule of preferred ratings, C37.6-1945, pages 28-31.

4-6.16 (20.15.050) Operating Duty (Duty Cycle). The operating duty of a circuit breaker consists of a specified number of unit operations at stated intervals.

4-6.17 (20.15.055) Unit Operation. The unit operation of a circuit breaker consists of a closing followed immediately by its opening without purposely delayed action, the letters "CO" signifying the operations of the breaker: CLOSING-OPENING.

4-6.18 Standard Operating Duty (Standard Duty Cycle). The standard operating duty of a circuit breaker shall be 2 unit operations, CO, with a 15-second interval between operations. For oil circuit breakers of the non-oil-tight construction, the interval shall be 2 minutes.

4-6.19 Operating Duty for Standard and Reclosing Service (Duty Cycle for Standard and Reclosing Service)

4-6.19.1 Oil-Tight Breakers. The percentages specified in Table 1, page 32, American Standard Operating Duty (Duty Cycle) for Standard and Reclosing Service, C37.7-1945, shall be used to determine the interrupting rating for oil-tight oil circuit breakers when operated according to the operating duty specified in these tables. (See 4-6.18 for standard operating duty)

4-6.19.2 Non-Oil-Tight Breakers. The percentages specified in Table 2, page 32, C37.7-1945, shall be used to determine the interrupting ratings for non-oil-tight oil circuit breakers when operated according to the operating duties listed in this table. Note that the standard operating duty for non-oil-tight breakers is 2 CO operations with a 2-minute interval.

4-6.20 Interrupting Performance

4-6.20.1 Oil Breaker. An oil circuit breaker shall perform at or within its rated interrupting current without emitting flame or an appreciable quantity of oil. For breakers of non-oil-tight construction, the emission of limited quantities of oil may be permitted.

4-6.20.2 Oilless Breaker. An oilless circuit breaker shall perform at or within its rated interrupting current without emitting appreciable flame.