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Procedures for Field Inspection and Performance Verification of Molded Case Circuit Breakers Used in Commercial and Industrial Applications

NEMA

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION ● 2101 L STREET, N.W., WASHINGTON, D.C. 20037

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Foreword

This Standards Publication is intended to provide a basis of common understanding within the electrical community regarding proper procedures for field inspection and performance verification of molded case circuit breakers used in industrial and commercial applications and rated up to 1000 volts.

To assure a meaningful publication, copies were sent during the draft stage to a number of individuals and organizations in the public and private sector having an interest in or responsibility for the purchase, testing, application, use, and maintenance of these products. Their resultant comments and suggestions provided a vital user and general interest input prior to final NEMA approval and resulted in a number of substantive changes in this publication. This publication will be periodically reviewed by the Molded Case Breaker Section of NEMA for any revisions necessary to keep it up to date with advancing technology. As future revisions are proposed, it is intended that the same or similar individuals or organizations will be offered a further opportunity to participate in the development of the publication. Proposed or recommended revisions should be submitted to:

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Scope

This Standards Publication is intended to set forth, for the use of qualified maintenance personnel, a number of basic procedures for the field inspection and performance verification of molded case circuit breakers used in industrial and commercial applications and rated up to 1000 volts.

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PROCEDURES FOR FIELD INSPECTION AND PERFORMANCE VERIFICATION OF MOLDED CASE CIRCUIT BREAKERS USED IN COMMERCIAL AND INDUSTRIAL APPLICATIONS

(Approved as Authorized Engineering Information 11-15-1984)

Section 1

GENERAL

The *National Electrical Code*[1] states that the purpose of overcurrent protection, as provided by a circuit breaker, is "... to open the circuit if the current reaches a value that will cause an excessive or dangerous temperature in conductors or conductor insulation."

The *National Electrical Code* defines a circuit breaker as: "A device designed to open and close a circuit by nonautomatic means, and to open the circuit automatically on a predetermined overcurrent without injury to itself when properly applied within its rating."

A molded case circuit breaker is one that is assembled as an integral unit in a supportive and enclosed housing of insulating material.

NOTE: Throughout this publication, the term "circuit breaker" refers to a "molded case circuit breaker."

Molded case circuit breakers are tested and the tripping time calibrated at the manufacturer's plant. These tests are typically based on recognized standards, such as NEMA AB 1, *Molded Case Circuit Breakers*[2] or Underwriters Laboratories, Inc.'s *Standard for Safety for Molded Case Circuit Breakers and Circuit-Breaker Enclosures*, UL 489[3]. Since circuit breakers have factory-calibrated and sealed elements, any unauthorized modification jeopardizes the manufacturer's warranty.

Molded case circuit breakers have an excellent record of reliability. This reliability depends on proper application, correct installation, the environment in which installed, and performance of maintenance as recommended by the manufacturer. A circuit breaker only operates when abnormal current conditions exist. Thus, it is not unusual for a circuit breaker to be in service for extended periods and never be called upon to trip because of an overload or short circuit.

Therefore, a program of inspection and preventive maintenance according to the manufacturers' recommendations, or as outlined in Section 2 of this publication, is recommended. It may also be desirable to perform field testing following the procedures covered in Section 4 of this publication, Verification Test Procedures.

Checking the condition and basic electrical operation of circuit breakers is important. However, values obtained according to the procedure for overcurrent trip tests should not be directly compared with published time/current characteristic curves which are developed under closely specified and controlled conditions. When questionable conditions or results are obtained when conducting inspection and performance tests, the manufacturer should be consulted. If it is necessary to return a circuit breaker to the manufacturer, proper packaging and packing material should be used to avoid shipping damage.

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[1] NFPA Pub. No. 70-1984, available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
[2] AB 1-1975 (R 1981) available from the National Electrical Manufacturers Association, 2101 L Street, N.W., Washington, D.C. 20037.
[3] UL 489-1982 available from Underwriters Laboratories, Inc., Publications Stock, 333 Pfingsten Road, Northbrook, IL 60062.

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Section 2

INSPECTION AND PREVENTIVE MAINTENANCE FOR COMMERCIAL AND INDUSTRIAL CIRCUIT BREAKERS

WARNING: Hazard of electrical shock or burn exists whenever working in or around electrical equipment. Inspection and maintenance steps must be made only on circuit breakers and equipment which are deenergized, disconnected, and isolated so that no accidental contact can be made with live parts.

Experience has shown that molded case circuit breakers require very little maintenance; however, a few simple inspection and maintenance procedures carried out on a regularly scheduled basis are recommended. Under normal conditions of use, when setting up such an inspection and maintenance schedule, it is suggested that the following procedures be followed. For additional assistance in establishing a proper inspection and maintenance schedule for your particular application consult the manufacturer.

1. With the breaker enclosed as in normal use and under load, check the face of the breaker (if visible) and the adjacent dead front surfaces of the enclosure. If the surface temperature does not permit maintaining contact with the palm of the hand for at least 3 seconds, it may be an indication of trouble and investigation is necessary. Please note that after initial energization, the breaker may not reach maximum temperature until it has carried a load for 3 hours.

   WARNING: BEFORE PERFORMING ANY OF THE FOLLOWING OPERATIONS, DEENERGIZE AND ISOLATE THE EQUIPMENT AND CHECK THE VOLTAGE OF ALL INCOMING LINE TERMINALS AND BETWEEN THESE TERMINALS AND GROUND TO POSITIVELY ASCERTAIN THAT THE EQUIPMENT IS TOTALLY DEENERGIZED, AND WILL REMAIN DEENERGIZED DURING THESE PROCEDURES. THE DISCONNECTING OR ISOLATING MEANS ON THE LINE SIDE OF THE DEVICES BEING CHECKED SHOULD BE LOCKED IN THE "OFF" POSITION.

2. Operate the breaker "ON" and "OFF" 5 to 6 times to insure that the mechanical linkages are free and to exercise the contacts.
3. Trip, reset, and close the breaker several times if the breaker is provided with mechanical trip provisions. Such action will insure that latching surfaces are operational.
4. Open the enclosure and verify that the breaker has been properly applied as to its type and rating in accordance with the manufacturer's instructions.
5. Clean the circuit breaker surfaces of any dust, dirt, soot, grease, or moisture. Use a lint free dry cloth, brush, or vacuum cleaner. Avoid blowing dirt into the circuit breaker or other equipment. If such contamination is found, it is recommended that steps be taken to eliminate the source.

   CAUTION: CERTAIN COMMERCIAL CLEANERS ATTACK THE PLASTIC MATERIALS OF THE BREAKER. VERIFY SUITABILITY OF ANY CLEANER BEFORE USING.

6. Examine the breaker case for cracks. The integrity of the circuit breaker case is important in withstanding the stresses imposed during short circuit interruptions. Breakers should be replaced if cracks are found.
7. Check all electrical components for evidence of overheating or looseness and verify that the ampacity of the conductors is correct. Overheating of a connection is indicated by discoloration of metal parts, melting or blistering of adjacent wire insulation or pitting or melting of connection surfaces due to arcing.
   a. If there is no evidence of overheating or looseness do not disturb or tighten the connections.
   b. If there is evidence of overheating, copper circuit breaker terminals and branch bus bars normally can be cleaned by carefully disassembling the connection and carefully dressing the contact surfaces with fine aluminum oxide paper. Aluminum wire connector lugs or branch bus bars that are damaged by overheating or arcing must be replaced. Be sure to remove all metal and abrasive particles before reassembling.
   c. Remove any damaged portion of the wire or cable.
   d. After cleaning or replacement, all connections should be tightened to recommended torque levels.

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8. If the circuit breaker has an interchangeable trip unit, remove the circuit breaker cover and check the internal connections at terminals of the trip unit for overheating or looseness.
   a. If there is no evidence of overheating or looseness do not disturb or tighten the connections.
   b. If there is evidence of overheating at any of the trip unit connections, the trip unit should be removed. Verify that the threaded inserts in the circuit breaker base have not been stripped or cross-threaded. If the threaded inserts are damaged the circuit breaker should be replaced. If the inserts are in good condition, clean the connections as noted above, tighten the connection bolts following the manufacturer's instructions and replace the circuit breaker cover.
   c. Operate the breaker "ON" and "OFF" and trip it several times to insure that the mechanism is free and in proper working order.

Consult the manufacturer, if any other information is required.

Section 3

CIRCUIT BREAKER TRIPPING CHARACTERISTICS

Molded case circuit breakers used in distribution systems generally have both time-delay and instantaneous tripping devices.

1. Time-delay tripping devices have inverse characteristics, i.e., the greater the overload, the less time required to trip. Circuit breakers with these devices have the following characteristics:
   a. Circuit breakers are calibrated for time-delay tripping at 125% of their continuous rating, at an ambient of 40°C. (This is generally considered equivalent to tripping at 135% of rated current, at 25°C.) All molded case circuit breakers are also calibrated to carry 100% of their rating (the marked current rating) continuously without tripping when tested as defined in Section 6.
   b. Circuit breakers have sufficient time delay prior to tripping to hold in under moderate overloads of short duration and motor starting applications.
   c. Circuit breakers will trip more quickly under severe overloads, providing adequate protection for circuit conductors.
2. Instantaneous or "magnetic" tripping devices respond to high fault currents and open the circuit breaker without intentional delay. This characteristic has the following advantages:
   a. It limits the duration of the short-circuit current to a minimum amount of time, thus giving maximum protection to the circuit conductors and to the circuit breaker itself.
   b. It limits damage at the point of fault.

Time-delay circuit breakers having a frame size of 150 amperes or less generally have no provision for adjusting the magnetic setting. Circuit breakers of larger frame sizes may have adjustable magnetic trip devices whereby the current value at which the instantaneous trip will operate can be set by the user.

Thermal sensitive circuit breakers can trip from exposure to continuous currents beyond their ratings, unduly high ambient temperatures, poor or improper connections, damaged plug-in members, and other conditions which transfer undue heat to the thermal tripping means. Installation conditions should comply with the manufacturers' application specifications and the *National Electrical Code*. For example, a molded case circuit breaker applied in a panelboard should not be loaded in excess of 80% of its continuous current rating if, in normal operation, the load will continue for 3 hours or more. This application is covered in Section 384-16(c) of the *Code*. An exception is permitted when the assembly, including the overcurrent device, is approved for continuous duty at 100% of its rating.

Serious damage to switchgear, raceways, and panelboards may occur at current levels below those necessary to activate overcurrent protective devices such as circuit breakers and fuses. These fault currents develop mainly on systems above 150 volts to ground, and are usually initiated as arcing faults to ground. The high impedance of this type of fault can keep the fault current below the minimum tripping level of the overcurrent device. Such ground faults can develop high power, and the high energy and extreme temperatures can cause damage to the equipment. Protection against such occurrences should be considered for installations involving voltages above 150 volts to ground by the application of ground fault sensing and interrupting equipment.

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Section 4

VERIFICATION TEST PROCEDURES

WARNING: Hazard of electrical shock or burn exists whenever working in or around electrical equipment. Inspection and maintenance steps should be made only on circuit breakers and switches which are deenergized, disconnected, and isolated, so that no accidental contact can be made with live parts.

The following tests should be performed by qualified personnel. These tests assist in good maintenance practice and aid in assuring that a circuit breaker is functioning properly. It should be kept in mind that the time-delay overcurrent trip test, as described in this publication, is not detailed enough to accurately duplicate a manufacturer's published calibration performance curves.

The following tests can be performed economically and with a minimum of equipment when a need is indicated.

1. Mechanical Trip Test
2. Insulation Resistance Test
3. Individual Pole Resistance Test (Millivolt Drop Test)
4. Time-Delay Overcurrent Trip Test
5. Instantaneous Overcurrent Trip Test
6. Rated Current Hold-In Test

1. Mechanical Trip Test

NOTE: CIRCUIT BREAKER NEED NOT BE REMOVED FOR THIS TEST.

Trip, reset, and close the breaker several times if the breaker is provided with mechanical trip provisions. Such action will insure that latching surfaces are free.

2. Insulation Resistance Test

The insulation resistance test is used to determine the quality of the insulation between live parts in adjacent poles of a circuit breaker and from each pole to ground.

CAUTION: Prior to conducting this test, consult the manufacturer's instructions, since the high voltages used may damage electronic components.

The resistance test is made with a direct-current voltage to determine the actual resistance of the insulation. Such resistance tests should be conducted with megohm type devices having outputs of 500-1000 volts. In general, more reliable information is obtained when 1000-volt instruments are used because they are more likely to detect deteriorated insulation surfaces. If resistance values are below 1 megohm the manufacturer should be consulted or the circuit breaker replaced.

Due to the high voltages involved, strict adherence to the safety procedures recommended by the manufacturer of the insulation resistance device is required.

The insulation resistance test is performed as follows:

a. Between line and load terminals of individual poles with the circuit breaker in the "OFF" position.

b. Between terminals of adjacent poles and from terminals to any metallic supporting structure with the circuit breaker in the "ON" position. The latter test should be conducted with the circuit breaker bolted to a metallic baseplate to simulate in-service mounting. Any exposed metallic parts of the circuit breaker shall also be connected to the base plate.

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3. Individual Pole Resistance Test (Millivolt Drop)

The electrical integrity of connections and contacts in a circuit breaker can be detected by making a millivolt drop test across the line and load terminals of each pole with the circuit breaker contacts closed.

The manufacturer should be consulted in order to determine the acceptable millivolt drop for the circuit breaker under test. It will vary for different ampere ratings and different manufacturers. It is recommended that this test be made with a 24 volt, or less, direct current supply; at a current set at 100% of the circuit breaker rating up to 500 amperes, and with a minimum of 500 amperes for breakers rated more than 500 amperes.

The millivolt drop across each pole is measured for comparison with the manufacturer's submitted data. If such data is not available, it may be practical to compare the test values with those for poles of other circuit breakers of similar ampere ratings from the same manufacturer.

The millivolt drop test is performed as follows:

a. Start with the breaker at room temperature.
b. Apply test current across a pole and record the millivolt drop and the test current. Do not maintain current for more than 10 seconds.
c. Operate the breaker mechanically without load.
d. Repeat Steps b and c for a total of 3 readings.
e. Repeat Steps a through d for each pole of the circuit breaker.

If the average test values on any pole of the breaker exceed the manufacturer's data, a potential overheating condition may be indicated and the circuit breaker should be replaced. For additional guidance, consult the manufacturer.

4. Time Delay Overcurrent Trip Test

The low-level overcurrent tripping characteristics of a circuit breaker can be verified by using a low voltage, high current source such as those used to perform the tests described in this publication (see Figure 4-1).

For circuit breakers rated above 250 amperes or when greater accuracy is required; the use of custom built test equipment or the services of the manufacturer or other qualified service organization should be considered.

For circuit breakers rated over 600 amperes, it is most practical to utilize the services of the manufacturer or other qualified service that is equipped to perform field tests. This is due to the need for special high current equipment, as well as the difficulty of making suitable test connections.

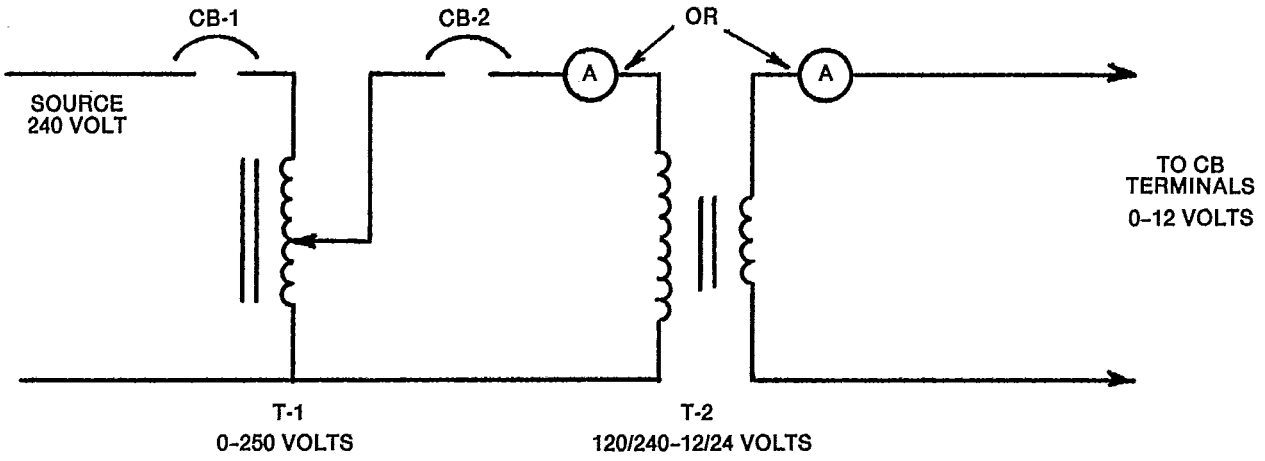
Manufacturers of circuit breakers with electronic trip units have testers available for verifying the operation of each function provided by the trip unit. The tester may be a separate device and can be used only with the trip unit or units for which it is designed. Manufacturer's instructions should be carefully followed to assure accurate results.

> NOTE: If a tester is not available, circuit breakers with electronic trip units can be tested by using a low voltage high current source. The procedures given for other types of circuit breakers of equivalent ratings should be followed.

TEST EQUIPMENT

The circuit diagram and equipment shown in Figure 4-1 is suggested for testing ratings up to 100 amperes. The main circuit breaker (CB1) must be rated to match the ratings of the two transformers and to carry the current for the highest time-delay overcurrent run. With transformers T1 and T2 coordinated, pulses up to 400% of the transformer ratings and of not more than 10 seconds, with a 3-minute rest period between pulses, should not thermally overburden the transformers. Test equipment for higher current ratings will require larger components.

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The following or similar equipment may be employed:

A - Ammeter
T1 - Adjustable Auto Transformer, 45 Amperes
T2 - Buck-Boost Transformer (Dual Primary and Secondary Coils Not Shown)
CB1 - Main Circuit Breaker, 50 Amperes
CB2 - Control Circuit Breaker, 30 Amperes

Figure 4-1
TYPICAL SCHEMATIC ARRANGEMENT FOR TESTING MOLDED CASE CIRCUIT BREAKERS RATED 100 AMPERES OR LESS

TESTING CONSIDERATIONS

When testing circuit breaker tripping characteristics, it is recommended that the overcurrent tests be performed on individual poles at 300% of rated current. The response of the circuit breaker to this overload will be indicative of its response throughout its entire overcurrent tripping range. This load has been chosen as the test point because it is relatively easy to obtain the required current in the field and the wattage per pole from line to load is low enough so that transfer of heat into the nonactive pole spaces is minor and does not affect the test results appreciably.

TEST PROCEDURE

Circuit breaker terminals should be connected to the test apparatus by cable or bus sized to the circuit breaker ampere rating. Plug-in or drawout circuit breakers require specialized connections.

a. Connect one pole as noted above.
b. Starting with the test breaker at room ambient temperature energize the circuit and quickly adjust the transformer (T-1) to maintain the required current flow through the test pole and start timing.
c. Record time to trip.
d. Repeat steps a, b, c on each of the other poles.

NOTE: For circuit breakers with thermal trip elements, wait at least 20 minutes before repeating the test. Tests on adjacent poles must be made at no less than 5-minute intervals. If the intervals are shortened, subsequent tests will result in premature tripping. If more accurate results are required, the between-test intervals should be extended to permit the temperature of the circuit breaker to return to that of the surrounding ambient air.

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EVALUATION OF RESULTS

Under normal test conditions, the circuit breaker will trip in less time than the maximum values shown in Table 4-1. Under improper test conditions, it is possible to exceed these maximum values. It should be noted that these maximum trip times are less than the times that have been established for cable protection using the *National Electrical Code* ampacity values.

Table 4-1
VALUES FOR OVERCURRENT TRIP TEST
(At 300% of Rated Continuous Current of Circuit Breaker)

Breaker Voltage Volts	Range of Rated Continuous Current Amperes	Maximum Trip Time In Seconds*
240	15-45	50
240	50-100	70
600	15-45	70
600	50-100	125
240	110-225	200
240	250-400	300
600	110-225	250
600	250-400	300
600	450-600	350
600	700-1200	500
600	1400-2500	600
600	3000-5000	650

*For integrally-fused circuit breakers, trip times may be substantially longer if tested with the fuses replaced by solid links (shorting bars).

Consult the manufacturer if additional information is required.

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Section 5

INSTANTANEOUS OVERCURRENT TRIP TEST

These tests are intended to verify functioning of the instantaneous trip systems of the breaker with marked instantaneous trip settings. Consult the manufacturer regarding applicable test criteria for breakers without such markings.

In verification testing, it is more important to determine that the instantaneous trip feature is operating and will trip the circuit breaker, than to determine the exact current value at which the instantaneous trip feature operates. *The necessary precise control of test conditions will probably make it impractical to duplicate the manufacturer's published data.*

Since the instantaneous trip characteristics of the circuit breaker can be greatly influenced by stray magnetic fields, the test setup must be made in such a way that the fields caused by the test equipment itself, by steel enclosures, or mounting plates, or by the conductors to the circuit breaker, do not affect the test results. Results can also be influenced by the wave shape of the current and, therefore, it is desirable to have sinusoidal output from the supply equipment. Manufacturers may be consulted for individual recommendations on mounting and wire routing if desired.

Equipment similar to that shown in Figure 4-1 will be suitable for these tests.

It should be recognized that on circuit breakers in the larger frame sizes the instantaneous overcurrent trips have adjustable settings, typically from 5 times "(Lo)" to 10 times "(Hi)" times the continuous current rating. The test methods and equipment suggested here can be expected to produce data that will compare to manufacturer's published information as shown in Table 5-1.

Table 5-1
INSTANTANEOUS TRIP SETTING TOLERANCES

Frame Size, Amperes		Tolerances of High and Low Settings	
		Hi	Lo
≤250	FACTORY	±20%	±25%
	FIELD	+40% −25%	+40% −30%
≥400	FACTORY	±20%	±25%
	FIELD	±25%	±30%

Testing of the instantaneous trip feature may utilize the "run-up" method or the "pulse" method:

A. Run-Up Method

While the run-up method utilizes simpler less expensive equipment, it produces less accurate data than the pulse method. The run-up method involves the following steps:

a. Connect one pole of the test breaker to the test equipment.
b. Set the current control to a point where approximately 70% of the expected instantaneous tripping current will flow when energized.
c. Turn power on and increase current until the circuit breaker trips. Recommended time for increasing the current is between 2 and 5 seconds. If the circuit breaker does not open within 5 seconds, the supply circuit should be de-energized to prevent damage to the test equipment.

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The run-up method requires skill on the part of the operator in recognizing the relationships between actual current and the meter indication. If the current is increased too slowly, tripping may be caused by the time delay element, especially if more than one test is run. If the current is increased too rapidly, an erroneous current reading may be obtained because the meter lags behind the actual current value due to meter damping. The problem can be overcome, and the accuracy of the method improved by the use of a calibrated oscillograph to read the current level at the time the breaker trips.

B. Pulse Method

This method will be more accurate than the run-up method if done properly, but it requires that the test equipment be equipped with a pointer-stop ammeter, a calibrated image-retaining oscilloscope, or a high speed sampling rate digital ammeter. It involves the following steps:

a. After the circuit breaker is connected, current is applied in short pulses of 5 to 10 cycles.

b. The current is increased on each succeeding pulse until the circuit breaker trips.

c. The current is then reduced to just below that point and recorded.

d. The current can then be raised slightly and re-checked at the current at which the circuit breaker trips. Although this method is a more accurate procedure, it is subject to an error introduced by current offset. Figure 5-1 depicts the distortion of the pulse current commonly called offset or asymmetrical waveshape.

C. Evaluation of Results

If the results of these tests differ significantly from the values shown in Table 5-1, consult the manufacturer.

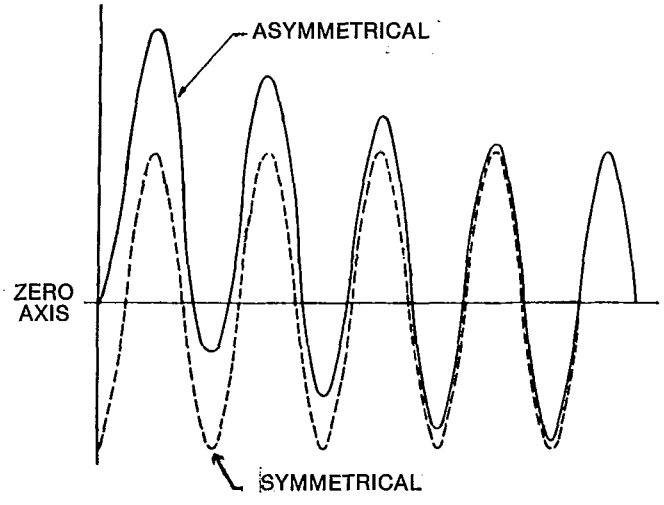


Figure 5-1
CURRENT WAVE SHAPES

An offset current results from closing the circuit at that point of the cycle where the voltage-current relationship results in an asymmetrical current. Experience with field test equipment indicates that the offset may be as high as 20%. A circuit breaker can be tripped by the offset peak rather than the steady-state current so that the effect of the error is that the indicated trip current may be as much as 20% lower than the peak offset current which tripped the circuit breaker. In factory testing, this error is avoided by (1) using synchronous closing of the current control to make contact at a point on the 60-Hertz wave so that no offset current occurs, and (2) reading current values on a calibrated image-retaining cathode ray oscilloscope or graphic recorder.

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Section 6

RATED CURRENT HOLD-IN TEST

This test is intended to verify the capability of a molded case circuit breaker to carry its rated current and should be performed only if the circuit breaker has been tripping under normal load conditions.

This test should be performed at normal room ambient (25 °C) utilizing a low voltage power supply.

The circuit breaker should be tested with all poles connected in series by conductors approximately 4 feet long per terminal (8 feet between poles) of the proper ampacity. All connectors shall be tightened to the recommended torque marked on the circuit breaker (or UL recommended values as found in UL 489).

The circuit breaker should not trip when rated current is applied for a period of 1 hour for breakers rated ≤ 100 amperes or 2 hours for breakers rated greater than 100 amperes. If tripping does occur, reset and operate the device several times under load then test again. If tripping continues, the circuit breaker should be replaced.

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September 1984

NEMA STANDARDIZATION

The purpose of NEMA Standards, their classification and status are set forth in certain clauses of the NEMA Bylaws, which are quoted below:

Purpose of Standards

National Electrical Manufacturers Association Standards are adopted in the public interest and are designed to eliminate misunderstandings between the manufacturer and the purchaser and to assist the purchaser in selecting and obtaining the proper product for its particular need. Existence of a National Electrical Manufacturers Association Standard does not in any respect preclude any member or nonmember from manufacturing or selling products not conforming to the standard.

(Bylaw—Art. V, Sec. 1)

Definition of a Standard

A standard of the National Electrical Manufacturers Association defines a product, process or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, rating, testing, and the service for which they are designed.

(Bylaw—Art. V, Sec. 2, Subsection A)

Dimensions

Where dimensions are given for interchangeability purposes, alternate dimensions satisfying the other provisions of the standards publication may be capable of otherwise equivalent performance.

(NEMA Policy Memorandum 84-2, dated June 7, 1984)

Classes of Standards

National Electrical Manufacturers Association Standards are of two classes:

1. NEMA Standard, which relates to a product commercially standardized and subject to repetitive manufacture, which standard has been approved by at least 90 percent of the members of the Subdivision eligible to vote thereon;
2. Suggested Standard for Future Design, which may not have been regularly applied to a commercial product, but which suggests a sound engineering approach to future development, which standard has been approved by at least two-thirds of the members of the Subdivision eligible to vote thereon.

(Bylaw—Art. V, Sec. 2, Subsection B)

Authorized Engineering Information

Authorized Engineering Information consists of explanatory data and other engineering information of an informative character not falling within the classification of NEMA Standard or Suggested Standard for Future Design.

(Bylaw—Art. V, Sec. 6, Ist Sentence)

Official Standards Proposal

An Official Standards Proposal is an official draft of a proposed standard which is formally recommended to an outside organization(s) for consideration, comment and/or approval.

(Bylaw—Art. V, Sec. 4, Subsection A)

Identification of Status

Standards in NEMA Standards Publications are identified in the foreword or following each standard as "NEMA Standard" or "Suggested Standard for Future Design." These indicate the status of the standard. These words are followed by a date which indicates when the standard was adopted in its present form by the Association.

The material identified as "Authorized Engineering Information" and "Official Standards Proposal" is designated similarly.

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MOLDED CASE BREAKER SECTION
OF THE
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

MEMBER COMPANIES

Challenger Electrical Equipment Corp.
Malvern, PA 19355

Crouse-Hinds Company
Earlysville, VA 22936

Eaton Corporation
Cutler Hammer Products
Milwaukee, WI 53216

Federal Pacific Electric Company
Raleigh, NC 27607

General Electric Company
Plainville, CT 06062

Heinemann Electric Company
Lawrenceville, NJ 08648-0800

Kockner Moeller Corp.
Natick, MA 01760

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Palatine, IL 60067

Unicorn Electrical Products
Anaheim, CA 92806

The Wadsworth Electric Mfg. Co.
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