NEMA Standards Publication

NEMA AB 4-2017

Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications

National Electrical Manufacturers Association

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Foreword

This NEMA standards publication supersedes and fully replaces NEMA AB 4-2003. To ensure that a meaningful publication was being developed, draft copies were sent to a number of individuals and organizations in the public sector having an interest in or responsibility for the purchase, testing, application, use, and preventive maintenance of these products. Their resulting 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 Circuit Breaker Voting Classification of NEMA for any revisions necessary to keep it up to date with advancing technology. Proposed or recommended revisions should be submitted to:

Senior Technical Director, Operations
National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, Virginia 22209

This standards publication was developed by the Molded Case Circuit Breaker Voting Classification of the National Electrical Manufacturers Association. Approval of this standard does not necessarily imply that all voting classification members voted for its approval or participated in its development. At the time it was approved, the Molded Case Circuit Breaker Voting Classification had the following members:

Eaton Corporation—Pittsburgh, PA
General Electric—Plainville, CT
Siemens Industry, Inc.—Norcross, GA
Schneider Electric USA —Andover, MA
ABB Inc.—Memphis, TN

Introduction

ANSI/NEMA AB 4 deals with “Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers used in Commercial and Industrial Applications.” These guidelines are to be used to identify circuit breakers requiring maintenance or replacement. Good practice includes periodic circuit breaker maintenance during plant shutdown or during a regular maintenance period as specified, for example, in NFPA 70B. When a circuit breaker operates automatically, good practice dictates that the source of the overcurrent should be located, and if it is suspected that the operation was at or near the interrupting rating, the circuit breaker’s condition should be checked prior to circuit re-energization.

When appropriately maintained, molded case circuit breakers provide reliable protection for many years. It would be impractical for any manufacturer to test their products’ lifecycle in each and every application. The exact lifetime of the breaker, however, is determined by the circuit breaker’s operational duty and by its environment.

With respect to operational duty, for some circuits there will be occasional overload conditions or low-current fault conditions. Here, the operating life will be tens of years. In other circuits, there may be high short-circuit-current faults but it should be noted that bolted faults at the interrupting rating of the breaker are rarely encountered. These will reduce the circuit breaker’s operating life and may necessitate circuit breaker replacement. Molded case circuit breakers are evaluated to the UL 489 (NEMA AB 1) standard *Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures*. They are subjected to thousands of endurance test operations (UL 489 Table 7.15.1); 50 overload test operations for circuit breakers rated up to 1600A and 25 operations for circuit breakers rated 2000A and higher (UL 489 Table 7.1.3.1); 3 to 7 interrupting tests, depending on breaker type, at limited fault current (UL 489 Table 7.1.7.1, 7.1.7.2, and 7.1.7.3); and two interrupting tests at maximum short-circuit-current rating. Thus circuit breakers have an extensive but finite interrupting capability, and breakers that experience multiple high short-circuit-current faults should receive a thorough inspection with replacement if necessary.

With respect to environmental effects, circuit breakers are sometimes exposed to high ambient temperatures, to high humidity, and to other ambient conditions that are hostile to long term performance. For example, industries may have corrosive environments or could be associated with dusty environments that could affect operating parts.

It is not intended that molded case circuit breakers be disassembled for inspection. Rather, NEMA AB 4 should be referenced during periodic maintenance or during specific inspection following a high short-circuit-current fault. This document is intended to ensure that molded case circuit breakers are well maintained, and provides guidelines for circuit breaker replacement.

This document is divided into separate clauses as follows:

Clause 1 presents the scope and reference standards.

Clause 2 details the safety procedures to be followed.

Clause 3 deals with general guidance.

Clause 4 deals with inspection procedures and describes thermal checks (4.2) and visual checks (4.3) of the enclosure and circuit breaker condition. Overheating of the circuit breaker would necessitate further investigation and cracks in the molded case would certainly necessitate circuit breaker replacement.

Clause 5 deals with preventive maintenance and ensures that the circuit breaker’s life is not compromised by external conditions. The objectives are that the circuit breaker operates in a clean environment and that the terminals are in good condition (5.2), that interchangeable trip units are connected properly (5.3), and that wire connectors are in good condition and are correctly torqued (5.4).

Clause 6 deals with non-destructive test procedures that can be used to verify specific operating characteristics of molded case circuit breakers. These include mechanical operation test (6.2), insulation resistance test (6.3), individual pole resistance test (millivolt drop test) (6.4), inverse time overcurrent test

(6.5), instantaneous overcurrent trip test (6.6), and rated hold-in test (6.7). Non-compliance to one or more of these tests could lead to circuit breaker replacement.

Clause 7 deals with the operation of accessory devices. Failure of an accessory would lead to replacement of that accessory or circuit breaker replacement if accessories are not removable.

Clause 8 deals with inspection and test procedures for insulated case circuit breakers, including checking and servicing the primary connectors and cradle (chassis) if so equipped, and checking a servicing the arc chutes, contacts and mechanism (if accessible).

Clause 9 deals with testing electronic trip units using secondary injection.

In summary, following an automatic overcurrent interruption at or near its interrupting rating, the condition of any protective device should be checked prior to circuit re-energization. For molded case circuit breakers, the condition of the circuit breaker is assessed without opening or disassembling the breaker. Circuit breakers that have experienced multiple high short-circuit-current faults, as evidenced by conditions at the source of the faults, should receive a thorough inspection per the guidelines of NEMA AB 4. This document should also be used for recommended, periodic, preventive maintenance.

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1. General

1.1 Scope

NEMA AB 4 sets forth, for use by qualified personnel,[1] a number of basic procedures that may be used for the inspection and preventive maintenance of molded case circuit breakers used in industrial and commercial applications rated up to and including 1000 V 50/60 Hz AC or AC/DC. Note—consult the manufacturer for DC-only or 400 Hz circuit breakers.

The methods outlined may be used to verify specific characteristics of a molded case circuit breaker that was originally built and tested in compliance with the requirements of NEMA standards publication AB 1 (UL 489). These methods are intended for field application and are, therefore, non-destructive in nature. Accordingly, these methods cannot be used to verify all performance capabilities of a molded case circuit breaker since verification of some capabilities requires tests of a destructive nature.

Many tests, including those of a destructive nature, as defined in AB 1 (UL 489), are performed on representative samples of circuit breakers by the manufacturer, as part of a routine program of factory inspection.

The AB 4 standards publication is not intended, nor is it adequate, to verify proper electrical performance of a molded case circuit breaker that has been disassembled (broken factory seal or removal of rivets), modified, rebuilt, refurbished, or handled in any manner not intended or authorized by the original circuit breaker manufacturer. Such breakers should be removed from service.

1.2 Referenced Standards

In this publication, reference is made to the latest edition of the standards listed below. Copies are available from the indicated sources:

National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

NFPA 70 *National Electrical Code®*
NFPA 70B *Recommended Practice for Electrical Equipment Maintenance*
NFPA 70E *Standard for Electrical Safety Requirements for Employee Workplace®*

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1300 North 17th Street, Suite 900
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NEMA AB 1 *Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures*[2]
NEMA AB 3 *Molded Case Circuit Breakers and Their Application*
NEMA 250 *Enclosures for Electrical Equipment (1000 Volts Maximum*)
NEMA GD 1 *Guidelines for Handling Water Damaged Electrical Equipment*

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[1] For purposes of these guidelines, a qualified person is one who has skills and knowledge related to the construction and operation of the electrical equipment and installation and has received safety training to recognize and avoid the hazards involved. In addition, the person is trained:
—and authorized to test, energize, clear, ground, tag, and lockout circuits and equipment in accordance with established safety practices.
—in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, and arc resistant clothing, in accordance with established safety practices.
—in first aid.
Refer to NFPA 70E, *Standard for Electrical Safety in the Workplace*, for electrical safety training requirements.

[2] NEMA AB 1 and UL 489 are the same.