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Establishing Levels of Selective Coordination for Low Voltage Circuit Breakers

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Foreword

This is a new NEMA Standards Publication. To assure that a meaningful publication was being developed, draft copies were sent other NEMA Product Sections having an interest in this topic. Their resulting comments and suggestions provided vital 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:

Vice President, Engineering
National Electrical Manufacturers Association
1300 North 17th Street
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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:

ABB, Inc.—New Berlin, WI
Eaton Corporation—Pittsburgh, PA
GE Industrial Solutions—Plainville, CT
Schneider Electric—Palatine, IL
Siemens Industry Inc.—Norcross, GA

Introduction

Circuit breaker manufacturers provide designers of electrical distribution systems with information that allows the designers to make decisions about choices in the types and ratings of these circuit breaker devices. Electrical system designers must select circuit breakers that satisfy overcurrent protection of the system, and also meet applicable National Electric Code (NEC) requirements for making sure these devices are selectively coordinated.

In support of providing guidance in designing properly protected and selectively coordinated electrical systems, the informational tools that circuit breaker manufacturers provide are in the form of Time-Current Curves (TCCs) and selective coordination tables. These tools are made available directly from the manufacturer or from third-party companies in either printed or electronic/software media. Exactly how the TCCs and selective coordination tools are to be used in designing electrical systems is outside the scope of this standard. (For an overview of the key system design considerations, refer to ABP-1).

Circuit breaker manufacturers use a variety of methods for developing these selective coordination tools. System designers must use this published information (TCCs and selective coordination tables) to conduct their selective coordination studies. In some cases, manufacturers conduct laboratory tests with fault currents flowing through pairs of circuit breakers connected together to determine the selective coordination relationship between the pair of circuit breakers. In other cases, test data from other laboratory tests are used in various analytical methods to establish a selective coordination relationship. Regardless of the methods used by circuit breaker manufacturers, currently the only reliable and approved source of information for conducting overcurrent analysis and selective coordination analyses by electrical system designers is through the information provided in selective coordination tools.

The primary purpose of this standard is to define the requirements for test procedures that shall be employed by circuit breaker manufacturers to validate the levels of instantaneous selective coordination data that are shown in selective coordination tools, for molded case, insulated case and low voltage power circuit breakers with instantaneous trip functions. In addition, the standard will briefly describe in general the acceptable analytical methods that may also be used to develop the data for selective coordination tools.

The intent of this standard is to insure that circuit breaker manufacturers are consistent in the methods that they use in validating the information that is published in selective coordination tools. In the Overload Current Region where fault currents are relatively low, selective coordination is fairly easy to accomplish between most devices. In the Overload Region, the Time-Current Curves of circuit breakers have for many years typically been an adequate tool for determining the Selective Coordination of devices. The standard will therefore instead focus specifically on the data for Selective Coordination tools. The standard is not intended to be used by electrical system designers as a guide in designing systems. For the purpose of system design, only the data from Selective Coordination tools should be used.

The goal of selective coordination is to isolate the faulted circuit, while maintaining power to the balance of the electrical distribution system. NEC Article 100 definitions related to selective coordination are as follows:

> **Coordination (Selective)**—Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the choice of overcurrent protective devices and their ratings or settings.
>
> **Overcurrent**—Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.
>
> **Overload**—Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload.

Other relevant definitions from The Authoritative Dictionary of IEEE Standards Terms, IEEE 100 include:

Short Circuit Current—An overcurrent resulting from a fault of negligible impedance between live conductors having a difference in potential under normal operating conditions.

Ground Fault—An insulation fault between a conductor and ground or frame.

With selective coordination, only the circuit breaker nearest to the fault should open to clear the fault. This overcurrent fault condition may be caused by an overload, a short circuit or a ground fault.

1. GENERAL

1.1 Scope

The scope of this standard includes all types of circuit breakers listed to:

1) The UL 489 *Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures*
2) The UL 1066 *Standard for Safety Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures*

The standard specifically addresses achieving selective coordination at high levels of short circuit fault current in the instantaneous region of the circuit breaker time-current curve by use of selective coordination tools. This requires taking into consideration more information than is typically found on conventional Time-Current Curves TCCs only.

This includes molded case circuit breakers and insulated case circuit breakers. It specifically addresses instantaneous selective coordination as achieving selective coordination at high levels of fault current, and may require taking into consideration more information than is typically found on conventional Time-Current Curves TCCs only.

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. Other references are listed at the end of this standard.

National Electrical Manufacturers Association
1300 North 17th Street
Rosslyn, Virginia 22209

AB 1 *Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures*[1]
ABP 1 *Selective Coordination*

National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

NFPA 70 *National Electrical Code®*

Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook, IL 60062

UL 1066 *Standard for Safety Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures*
UL 489 *Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures*

[1] NEMA AB 1 and UL 489 are the same standard