# Circuit Breaker Maintenance, Low Voltage

**4.5 Days, 3.2 CEUs**

Low voltage circuit breakers are one of the most critical elements, and of the most unacknowledged, overcurrent protection devices in any power system. Increased exposure to moisture and contaminants makes this type of circuit breaker very susceptible to failure. With proper maintenance, technicians can prevent nuisance trips, and ensure tripping operations execute as required. In addition to improving electrical system reliability by ensuring optimum fault clearing times, well maintained circuit breakers minimize the arc flash hazard energy levels that technicians can be exposed to during a fault. This course seeks to expound upon the science of a circuit breaker, the prescribed maintenance to increase its longevity, and how to read a wide variety of time characteristic curves.

Participants in this class will visually and electrically inspect circuit breakers according to manufacturer and NETA MTS requirements. Based on results of the tests, technicians should be able to make pass/fail decisions on circuit breakers.

This hands-on course is intended for new or experienced electricians and technicians that install, maintain, repair or troubleshoot power circuit breakers rated less than 1,000 volts AC and equipped with electromechanical or solid-state tripping devices.

## Lab and Classroom Attire

AVO is committed to the personal safety of each participant and requires safety glasses, long pants, and ANSI rated "safety-toe" work shoes for lab activities. Lecture courses may involve a tour of a work or shop area and for this reason open-toe shoes and shorts are not considered appropriate attire for the classroom.

## Learning Objectives

To receive 3.2 CEUs, participants must attend 4.5 days of class (32 contact hours) and attain a minimum average grade of 80% (overall grade will consist of 50% lab practice and 50% final exam). Upon completion of this course and lab practice, the participants will demonstrate that they are able to:

- Describe the different types of circuit breakers, their components, and functions.
- Perform circuit breaker and cabinet service maintenance service safely.
- Interpret and utilize time characteristic curves.
- Demonstrate all standard tests performed on a circuit breaker.

## SCOPE

**Day 1* (7 contact hours)**

I. Introduction (0.5 hr)

II. Introduction To Circuit Breaker Maintenance (1.5 hrs)
- A. Need for Maintenance
- B. Technical Literature
- C. Trained Personnel
- D. Spare Parts
- E. Tools and Test Equipment
- F. Approach Boundaries for Energized Work

III. Circuit Breaker Fundamentals (3 hrs)
- A. Definitions
- B. Nameplate Data
- C. Model Designation
- D. Components
- E. Operating Principles

III. Circuit Breaker Fundamentals (cont'd)
- D. Operating Principles (2 hrs)
  - 1. Mechanical Operation
  - 2. Electrical Operation

**Day 2 (7 contact hours)**

IV. Circuit Breaker and Cabinet Service (2 hrs)
- A. Circuit Breaker Removal
  - 1. Removal Procedure
  - 2. Racking Position
- B. Cabinet Service
- C. Circuit Breaker Service
- D. Testing
- E. Restoration of Service

*Class scheduling times may vary based on discussions and size of class

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## SCOPE (continued)

V. Overcurrent Protective Devices (5 hrs)
- A. History
- B. Series Trip Device Operation
- C. Solid-State Trip Device Operation
- D. Overcurrent Trip Device Malfunctions
- E. Curve Interpretation for a Direct-Acting Trip Device

**Day 3 (7 contact hours)**

V. Overcurrent Protective Devices (cont'd) (3 hrs)
- F. Long-Time Delay Band
- G. Short-Time Delay Band
- H. Instantaneous Current Curve
- I. Solid State Trip Devices
- J. Zone-Selective Interlocks
- K. Interpretation of a Solid-State Curve
- L. Testing Solid-State Trip Devices

VI. Lab (4 hrs)
- A. High Current Testing of Trip Devices (Primary Injection Method)

**Day 4 (7 contact hours)**

VII. Overcurrent Protective Devices (7 hrs) (cont'd)

Practical Exercises
1. Reading Overcurrent Devices
2. Calculating Device Operating Times

**Day 5 (half day) (4 contact hours)**

VIII. Miscellaneous (2.5 hrs)
- A. Records and Recordkeeping
- B. New Circuit Breakers
- C. Storage of New Circuit Breakers
- D. Checkout and Testing of New Circuit Breakers
- E. Storage of Spare Breakers

IX. Conclusion (1.5 hrs)
- A. Review
- B. Final Exam

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# STANDARD EQUIPMENT LIST

**Circuit Breaker Maintenance - Low Voltage**

Course Number: 134, Rev 5

REVISED: 9/16/202 BY: Cory Marchant DAYS: 4.5 DAYS

NOTE: All items indicated with an asterisk (*) must be supplied by the client on On-Site courses

| TEXT ( PER 1 STUDENT) | |
|---|---|
| **QUANTITY** | **ITEM** |
| 1 | CIRCUIT BREAKER MAINTENANCE - LOW VOLTAGE, #134, SEP 2022 |

| MATERIALS NEEDED (PER CLASSROOM) | |
|---|---|
| **QUANTITY** | **ITEM** |
| *1 | PROJECTOR OR TV WITH PROJECTION CAPABILITIES |
| *1 | DRY ERASE BOARD WITH MARKERS AND ERASERS |
| *10 | STUDENT TABLES |
| *10 | STUDENT CHAIRS |

| CLASSROOM MATERIAL (PER STUDENT) | |
|---|---|
| **QUANTITY** | **ITEM** |
| 1 | No. 2 MECHANICAL PENCIL |
| 1 | 12" CLEAR RULER |
| 1 | MAGNIFYING SHEET |
| 1 | CALCULATOR |

| TESTING EQUIPMENT (PER STUDENT) | |
|---|---|
| **QUANTITY** | **ITEM** |
| 1 | 5kV OR 10kV INSULATION RESISTANCE TESTER |
| 1 | DLRO-10x OR EQUIVALENT - DIGITAL LOW RESISTANCE OHMMETER |

| | |
|---|---|
| | HIGH CURRENT CIRCUIT BREAKER TEST SET-<br>NOTE: THE LIST BELOW SHOWS THE CAPABILITIES OF MEGGER HIGH CURRENT TEST SETS:<br><br>*DDA-6000 WILL TEST UP TO 6000A FRAME BREAKERS (LOCATED IN DALLAS)*<br>*DDA-3000 WILL TEST UP TO 3000A FRAME BREAKERS*<br>*DDA-1600 WILL TEST UP TO 1600A FRAME BREAKERS PS-9160 WILL TEST UP TO 6000A FRAME BREAKERS PS-9130 WILL TEST UP TO 3000A FRAME BREAKERS PS-1600 WILL TEST UP TO 1600A FRAME BREAKERS CB-845 WILL TEST UP TO 500A FRAME BREAKERS CB-832 WILL TEST UP TO 50A FRAME BREAKERS*<br><br>NOTE: THE TEST SETS MAY NOT ALWAYS BE CAPABLE OF TESTING THE FRAME SIZES SHOWN ABOVE DUE TO THE HIGH |
| *1 | RESISTANCE OF THE BREAKER |

| **MAINTENANCE - CLEANING PRODUCTS (PER CLASS)** | |
|---|---|
| **QUANTITY** | **ITEM** |
| 1 | BUNDLE OF CLEANING RAGS - (CLOTH) |
| 1 | BOX OF SCOTCHBRITE® PADS (GREEN OR BURGANDY) |
| 1 | 1-QUART CAN OF DE-NATURED ALCOHOL |
| 1 | 4-Oz CAN OF SANCHEM, NO-OX-ID, A-SPECIAL, GREASE |

| **MAINTENANCE - MISCELLANEOUS (PER CLASS)** | |
|---|---|
| **QUANTITY** | **ITEM** |
| 1 | BOX OF CARBON PAPER |
| 1 | BOX OF SCOTCHBRITE® PADS (GREEN OR BURGANDY) |
| 1 | 1-QUART CAN OF DE-NATURED ALCOHOL |
| 1 | 4-Oz CAN OF SANCHEM, NO-OX-ID, A-SPECIAL, GREASE |

| **INSTRUCTION MANUALS - DALLAS ONLY** | |
|---|---|
| **QUANTITY** | **ITEM** |
| 1 | ITE/ABB K-3000 AND K-4000/IB-9.1.7-4 |
| 1 | ITE/ABB K-225 THROUGH K-2000/IB-6.1.12.1-1E |

FOR VIRTUAL CLASSES:
CONTENT MATERIAL WILL BE PROVIDED IN DIGITAL FORMAT