

# Circuit Breaker Maintenance, Low Voltage

4.5 Days, 3.2 CEUs

Low-voltage power circuit breakers are one of the most critical and neglected 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.

Every overcurrent device and circuit breaker combination has its operation indicated on time current characteristic curves provided by the manufacturer. A good portion of this course deals with reading a wide variety of overcurrent trip devices and their corresponding 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 VAC, equipped with electromechanical or solid state tripping devices. The participant should have basic knowledge of AC/DC electricity.

## Lab and Classroom Attire

AVO is committed to the personal safety of each participant and requires appropriate wearing apparel for lab activities. Long pants and ANSI rated "safety toe" work shoes are acceptable as meeting this requirement.

## 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 participant will demonstrate that he/she is able to:

- Describe the different types of circuit breakers, their components, and functions.
- Perform circuit breaker maintenance service safely.
- Carry-out cabinet maintenance service safely.
- Demonstrate all standard tests performed on a circuit breaker.

## SCOPE

### Day 1 (7 contact hours)

- I. Introduction (0.5 hr)
  - A. Schedule
  - B. Course Outline
- II. Introduction To Circuit Breaker Maintenance (0.5 hrs)
  - A. The Need for Maintenance
  - B. Technical Literature
  - C. Trained Personnel
  - D. Spare Parts
  - E. Tools
  - F. Maintenance Justification

AM BREAK

- III. Circuit Breaker Fundamentals (3 hrs)
  - A. Definitions
  - B. Nameplate Data
    1. Voltage
    2. Frame Rating
    3. Continuous Current Rating
    4. Interrupting Rating
    5. Control Power
  - C. Components
    1. Main Stabs or Disconnects
    2. Auxiliary Stabs or Secondary Disconnects
    3. Ground Stab
    4. Interference Interlock

5. Seismic Positioner
6. Cell Switch
7. Bell Alarm and Lockout
8. Undervoltage Trip Device
9. High-Fault Protectors
10. Blown Fuse Indicators
11. Padlocking Device
12. Arcing Contacts
13. Intermediate or Secondary Contacts
14. Main Contacts
15. Auxiliary Contacts
16. Arc Chutes

Lunch

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

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## SCOPE (continued)

### III. Circuit Breaker Fundamentals (cont'd)

- D. Operating Principles (1.5 hrs)
  - 1. Mechanical Operation
  - 2. Electrical Operation

PM Break

### IV. Circuit Breaker and Cabinet Service (1.5 hrs)

- A. Circuit Breaker Removal
  - 1. Removal Procedure
  - 2. Racking Position
- B. Cabinet Service
- C. Circuit Breaker Service

#### Day 2 (7 contact hours)

### V. Overcurrent Devices (6 hrs)

- A. Overcurrent Device Development
- B. Overcurrent Devices
  - 1. Electromagnetic Overcurrent Device

AM Break

- 2. Long-Time-Delay Device
- 3. Short-Time-Delay Device
- 4. Instantaneous Device
- 5. Solid-State Overcurrent Devices

Lunch

### C. Practical Exercises

- 1. Reading Overcurrent Devices
- 2. Calculating Device Operating Times

### D. Malfunction Causes

- E. Setting Overcurrent Devices
- F. Interpretation of Low-Voltage Power Circuit Breaker Curves

PM Break

- G. Overcurrent Testing Procedures
- H. Timing Tests

### VI. Miscellaneous (1 hr)

- A. Records and Record Keeping
- B. New Circuit Breakers
- C. Storage of New Circuit Breakers
- D. Checkout and Testing of New Circuit Breakers
- E. Storage of Spare Breakers

#### Day 3 (7 contact hours)

### F. Labs

- 1. CB Maintenance and Disassembling
- 2. Electrical Test and Mechanical Adjustments
- G. Restoration of Service

#### Day 4 (7 contact hours)

### VII. Lab (7 hrs)

- High Current Testing of Trip Devices (Primary Injection Method)

AM Break

### VII. Lab (cont'd)

Lunch

### VII. Lab (cont'd)

PM Break

### VII. Lab (cont'd)

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

### VIII. Conclusion (4 hrs)

- A. Review

AM Break

- B. Final Exam

# STANDARD EQUIPMENT LIST

## CIRCUIT BREAKER MAINTENANCE LOW VOLTAGE

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CIRCUIT BREAKER MAINTENANCE LOW VOLTAGE (CBMLV)

REVISED: JANUARY 2, 2017

BY: TIM GAUTHIER

COURSE NUMBER 134, REV.2

4.5 DAYS

(THIS IS AN ONSITE OR DALLAS CLASS ONLY CH 7/18/12)

\*MUST BE SUPPLIED FOR ONSITE

### **Text**

1 / student                      *Circuit breaker maintenance, low voltage* (1,000 v or less)

### **Material**

1 / student                      magnifying sheet  
1 / student                      12 inch clear rulers  
1 / student                      red pencil  
\*1 / student                      calculator

### **Test equipment**

1 / class                      5 kv or 10 kv insulation resistance tester  
1 / class                      DLRO (digital low resistance ohmmeter 10 amp DLRO) or  
micro ohmmeter (mom-2)  
\*1 / class                      primary injection test set      (dda-6000 or equivalent)

### **\*Tools**

\*1 / 4 students                      standard substation toolbox (list attached)  
\*1 / class                      dial caliper  
\*1 / class                      1 box scotchbrite (green general purpose)  
\*1 / class                      tube/can conductive lube (no-ox-id special grade a)  
\*1 / class                      tube/can non-conductive lube (mobil 28 or equivalent)  
\*1 / class                      1 pt. Denatured alcohol  
\*1 / 6 students                      box or package lint free shop towels  
\*1 / class                      8 sheets carbon paper (optional)  
\*1 / student                      safety glasses

### **Lab equipment**

\*1 / 2 students                      480 volt power circuit breakers with instruction manuals