# Protective Relay Maintenance, Basic

**4.5 Days, 3.2 CEUs**

The Protective Relay Maintenance Basic course is an instructor-led, hands-on certification course covering overcurrent, bus differential, and transformer differential protective relays. Class participants will apply NETA testing standards, record test results, and utilize hand tools for proper relay adjustment and calibration.

This course is intended for electricians, technicians and engineers responsible for the testing, maintenance and calibration of relays that protect distribution feeders, transformers, buses, and loads. The participant should have basic knowledge of AC/DC electricity.

## Lab and Classroom Attire

AVO Training Institute is committed to the personal safety of each participant and require 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 the participants will demonstrate that they are able to:

- Explain the application of overcurrent, bus differential, and transformer relays.
- Identify critical relay components.
- Interpret AC and DC relay schemes.
- Perform as found/left tests and calibrate relays with the following functions (ANSI device number):
  - Instantaneous and Time Overcurrent (50/51)
  - Undervoltage (27)
  - Overvoltage (59)
  - Bus Differential (87B)
  - Transformer Percentage Differential with Harmonic Restraint (87T)
  - Targets and Indicators

## SCOPE

Day 1* (7 contact hours)

I. Introduction (0.5 hr)

II. Electrical Power Fundamentals (1.5 hrs)
- A. PQ Diagram
- B. RX Diagram
- C. EI Diagram
- D. Symmetrical Components
- E. Applying Fundamentals to Relay Testing

III. Introduction To Basic Relays (1.5 hrs)
- A. Purpose of Protective Relays
- B. The Art and Science of Protective Relaying

IV. Instrument Transformers (2 hrs)
- A. Current Transformers (CT)
- B. CT Connections
- C. Types of Current Transformers
- D. CT Ratios
- E. Determining CT Polarity
- F. Measuring Current
- G. Shorting CT Secondary Current Circuits
- H. Operation of Current Transformers at Excessive Burden or Open-Circuit Voltage
- I. CT Nameplate Data
- J. Potential Transformers (PT)
- K. PT Connections
- L. PT Ratios
- M. Determining PT Polarity
- N. PT Nameplate Data
- O. Understanding CTs and PTs in a Schematic

V. Introduction To Relaying (1.5 hrs)
- A. Classification of Relays
- B. Protective Zones
- C. Fundamentals of Electro-mechanical Design
- D. Relay Construction
- E. Time Characteristics
- F. Protective Relay Maintenance and Testing
- G. Mechanical and Visual Inspections
- H. Preventive Maintenance Testing
- I. Acceptance Testing
- J. Testing Techniques
- K. General Tests

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

***AVO Training Institute is accredited by the International Association for Continuing Education and Training (IACET) and is accredited to issue the IACET CEU***

# Protective Relay Maintenance, Basic

**4.5 Days, 3.2 CEUs**

## SCOPE (cont'd)

**Day 2 (7 contact hours)**

VI. Westinghouse Type CO Overcurrent Relay (2.5 hrs)
- A. Applications
- B. Types of CO Relays
- C. Components
- D. Operating Principles
- E. Protection Scheme
- F. Types of Tests
- G. Adjustments
- H. Timing
- I. Lab
  1. Pickup Test
  2. Timing Test
  3. Instantaneous Test
  4. Seal-In Test

VII. General Electric Overcurrent Relays (IAC) (2.5 hrs)
- A. Applications
- B. Types of IAC Relays
- C. Components
- D. Operating Principles
- E. Protection Scheme
- F. Types of Tests
- G. Adjustments
- H. Lab
  1. Pickup Test
  2. Timing Test
  3. Instantaneous Test
  4. Seal-In Test

VIII. Westinghouse Voltage Relays (CV) (2 hrs)
- A. Applications
- B. Types of CV Relays
- C. Components
- D. Operating Principles
- E. Protection Scheme
- F. Types of Tests
- G. Adjustments

PM Break
- H. Lab
  1. Pickup Test
  2. Timing Test
  3. Seal-In Test

**Day 3 (7 contact hours)**

IX.. General Electric Voltage Relays (IAV) (4 hrs)
- A. Applications
- B. Types of IAV Relays
- C. Components
- D. Operating Principles
- E. Protection Scheme
- F. Types of Tests
- G. Adjustments for IAV 51A Overvoltage Relays
- H. Adjustments for IAV 51E Undervoltage Relays

AM Break
- I. Lab (2 Hours)
  1. Pickup Test
  2. Timing Test
  3. Seal-In Test

Lunch

X. Introduction To Transformer Differential Relays (0.5 hr)
- A. Applications
- B. Operating Principles
  1. Basic
  2. Transformer Differentials
  3. Transformer Differentials with Harmonic Restraint

XI. Westinghouse Differential Relays (CA) (2 hrs)
- A. Applications
- B. Components
- C. Operating Principles
- D. Protection Scheme
- E. Testing
- F. Types of Tests
- G. Adjustments

**Day 4 (7 contact hours)**

XII. Westinghouse Differential Relays (HU) (2 hrs)
- A. Applications
- B. Components
- C. Operating Principles
- D. Protection Scheme
- E. Types of Tests
- F. Adjustments
- G. Lab
  1. Minimum Pickup Test
  2. Slope Test
  3. Harmonic Restraint Test
  4. Instantaneous Test
  5. Seal-In Test

AM Break

XIII. General Electric Type Transformer Differential Relay with Percentage and Harmonic Restraint (BDD) (2 hrs)
- A. Applications
- B. Components
- C. Operating Principles
- D. Protection Scheme
- E. Types of Tests
- F. Adjustments
- G. Lab (4 Hours)
  1. Minimum Pickup Test
  2. Slope Test
  3. Harmonic Restraint Test
  4. Instantaneous Test
  5. Seal-In Test

Lunch

XIV. General Electric Bus Differential Relay (PVD) (2.5 hrs)
- A. Applications
- B. Components
- C. Operating Principles
- D. Protection Scheme
- E. Types of Tests
- F. Adjustments

PM Break
- G. Lab
  1. Minimum Pickup 87L
  2. Minimum Pickup 87H
  3. Thyrite Leakage Test
  4. Seal-In Test

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

XV. Conclusion (4 hrs)
Review and Exam

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# EQUIPMENT LIST
# Protective Relay Maintenance, Basic

DEVELOPED: August 2021 BY: R. Parrett
COURSE NUMBER: 137 COURSE LENGTH: 4.5 days

**TEXT**

AVO Coursebook - Protective Relay Maintenance, Basic
Course 137, August 2021

**EQUIPMENT**

| | |
|---|---|
| 1 / student | Calculator |
| 1 / student | Multi bit screwdriver |
| 1 / class | Tool box (see attached |

**DEVICES**

| | |
|---|---|
| 1 / 2 students | GE test jacks |
| 1 / 2 students | States test jacks |
| 1 / 2 students | Westing CO-7, 8, 9 |
| 1 / 2 students | GE IAC 51, 53 |
| 1 / 2 students | West CV 1, 2, 4, 5, 6, 7 |
| 1 / 2 students | GE IAV 51A, 54E, 54F |
| 1 / 2 students | West CA |
| 1 / 2 students | West HU, HU 1 |
| 1 / 2 students | GE BDD 15, 16 |
| 1 / 2 students | GE PVD |

**TEST EQUIPMENT**

| | |
|---|---|
| 1 / students | SMRT 36 test set |
| 1 per test set | 25’ extension cord 14 GA multi-outlet |