

# Transformer Maintenance and Testing

4.5 Days, 3.2 CEUs

This course will cover maintenance, repairing or troubleshooting power transformers rated 765 kV or less. Participants will receive classroom instruction on Safety, Transformer Types, Components and Indicators, Nameplate Data Interpretation, Inspections, DC and AC Testing, Transformer Oil and Gas Testing, along with Filling, Filtering and Drying of transformers.

Hands-on labs include performing and evaluating results of insulation resistance, winding resistance, turns ratio, core excitation and power factor tests of windings and bushings, along with an optional instrument transformer test.

This course uses up-to-date test equipment and procedures for evaluating the condition of a transformer. Test results can provide predictive data which will guide maintenance activities and help to prevent catastrophic failure that may damage downstream equipment and endanger personnel.

## 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 and lab practice, the participant will demonstrate that he/she is able to:

- Describe the major categories and the most common designs of transformers.
- Identify power, instrument and distribution transformer components and auxiliary equipment.
- Demonstrate routine and diagnostic inspections and point out potential problems and hazards.
- Interpret nameplate data and use the data to set up correct test procedures.
- Simulate appropriate tests to evaluate the condition and perform maintenance on transformers.
- Discuss oil sampling and the correct procedures to obtain samples.
- Summarize testing, drying, filling and filtering techniques and procedures.
- Explain gas sampling and testing.
- Discuss test results to troubleshoot transformer problems.
- Determine the dryness of insulation using safety precautions, proper tools, vendor manuals and/or drawings.

## SCOPE

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

- I. Introduction (0.5 hr)
  - A. Schedule
  - B. Course Outline
- II. Safety for Technicians (0.5 hr)
  - A. Lab Safety Rules
  - B. On-the-Job Safety
- III. Transformer Types (1 hr)
  - A. Transformer Types
  - B. Transformer Designs
  - C. Cooling Classifications

AM BREAK

- IV. Components and Indicators (2 hrs)
  - A. Major Components
  - B. Indicators and Alarms

LUNCH

- V. Nameplate Data (1.5 hrs)
  - A. Transformer Nameplate
  - B. Nameplate Data Exercise

PM BREAK

- VI. Inspections (1.5 hrs)

- A. Visual (Routine) Inspections
- B. Diagnostic Inspections
- C. Recommendations for Testing and Maintenance

### Day 2 (7 contact hours)

- VII. Transformer DC (4 hrs)
  - A. General Safety Precautions
  - B. DC Testing

AM BREAK

- C. Insulation Resistance

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

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## SCOPE (cont'd)

- D. Winding Resistance Testing
- E. Lab – Winding Resistance Testing

LUNCH

### VIII. Transformer AC (3 hours)

- A. AC Testing
- B. Power Factor Testing Fundamentals
- C. Typical Tests Performed Using Power Factor/Dissipation Factor Test Sets
- D. Transformer Bushing Testing
- E. Liquid Insulating Power Testing
- F. Core Excitation Current Testing

PM BREAK

- G. Lab – Turns Ratio Testing a Transformer
- H. Lab – Power Factor/Dissipation Factor Testing

### Day 3 (7 contact hours)

#### IX. Transformer Oil Testing (7 hrs)

- A. Insulating Liquids
- B. Liquid Sampling
- C. Sampling for Power Factor Testing
- D. Sampling for Gas-In Oil Analysis

AM BREAK

#### IX. Transformer Oil Testing (cont'd)

- E. Dielectric Breakdown Voltage Test
- F. Color Testing

LUNCH

- G. Visual Examination
- H. Neutralization of Number Test

PM BREAK

- I. Interfacial Tension Test
- J. Moisture Content Test
- K. Liquid Insulating Power Factor
- L. Evaluation of Test Data

### Day 4 (7 contact hours)

#### X. Transformer Gas Testing (7 hrs)

- A. Gas Detection
- B. Oxygen Testing

AM BREAK

- C. Combustible Gas Testing

LUNCH

- D. Gas Analysis Interpretation

PM BREAK

- E. Lab – Insulation Resistance Testing

### Day 5 (Half Day) (4 contact hours)

#### XI. Filling and Filtering (1 hr)

- A. Reconditioning
- B. Filter and Filter Presses
- C. Centrifuges
- D. Vacuum Dehydrators
- E. Reclaiming
- F. Draining and Filling

AM BREAK

#### XII. Drying (1.5 hrs)

- A. Most Approved Dry Out Method
- B. Vacuum and Hot Oil Dry Out
- C. Other Common Drying Methods
- D. Determination of Dryness

#### XIII. Conclusion (1.5 hrs)

- A. Review
- B. Final exam

# STANDARD EQUIPMENT LIST

## TRANSFORMER MAINTENANCE AND TESTING

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REVISED 10/11/2017 BY: JIM CLOSSON/IBH  
COURSE NUMBER 142, REV6 – 4/2018  
4.5 DAYS

### **TEXT**

1 / STUDENT

*TRANSFORMER MAINTENANCE AND TESTING*  
COURSE #142 – 2017, Rev6, APRIL 2018

### **EQUIPMENT**

1 / STUDENT

CALCULATOR

1 / STUDENT

PENCIL

1 / CLASS

THREE PHASE TURNS RATIO TEST SET TTR (310;  
320; 330)

1 / CLASS

THREE PHASE WINDING RESISTANCE TEST SET  
(MTO 300)(*Demag function needed*)

1 / CLASS

12 kV CAPACITANCE & DISSIPATION FACTOR  
TEST SET (DELTA 4000) (*INCLUDE STATIC  
DISCHARGE GROUND CLUSTERS*)

2 / CLASS

MULTIMETER WITH CLIP LEADS

1 / CLASS

MULTI RATIO CT TESTER (MRCT OR EQUIVILANT)

1 / CLASS

INSULATION RESISTANCE TEST SET (SI SERIES)

1 / CLASS

OIL DIELECTRIC BREAKDOWN TEST SET (OTS  
60PB)

1 / CLASS

TESTED CLASS 00 GLOVES WITH PROTECTORS  
SIZE 11

1 / CLASS

TESTED CLASS 2 GLOVES WITH PROTECTORS  
SIZE 11

1 / CLASS

MEDIUM VOLTAGE PROXIMITY VOLTAGE  
DETECTOR (DETEX)

1 / CLASS

DISCHARGE STICK

1 / CLASS

25 FT. GROUNDING JUMPER

1 / CLASS

1 QUART TRANSFORMER OIL (*Can't be shipped*)

### **DEVICES**

1 / CLASS

500 KVA OR LARGER 3 PHASE TRANSFORMER

1 / CLASS

MULTI RATIO CT