

# 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**

**Course Number 142, Rev 6**

REVISED: 01/25.23

BY: Cory Marchant

DAYS: 4.5 DAYS

This list is based on a maximum class size of 10

**NOTE:** ALL ITEMS MARKED WITH AN ASTERISK (\*) MUST BE PROVIDED BY CLIENT FOR ON-SITES

**TEXT (FOR 1 STUDENT)**

<i>Transformer Maintenance and Testing - Course 142 - May 2019</i>
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**MATERIALS NEEDED (PER CLASSROOM)**

*1	PROJECTOR OR TV WITH PROJECTION CAPABILITIES
*1	DRY ERASE BOARD WITH MARKERS AND ERASERS
*5	STUDENT TABLES
*10	STUDENT CHAIRS

**EQUIPMENT NEEDED FOR TRAINING (PER CLASS)**

*1	500KVA OR LARGER 3-PHASE TRANSFORMER
*1	MULTI RATIO CURRENT TRANSFORMER (CT)

<b>ALL ELECTRICAL EQUIPMENT USED FOR THE HANDS-ON MUST BE DE-ENERGIZED, ISOLATED AND GROUNDED FROM ASSOCIATED GEAR</b>
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**TESTING EQUIPMENT (PER CLASS)**

Issued ea ITEM

1	THREE PHASE TURNS RATIO TEST SET (TTR)
1	THREE PHASE WINDING RESISTANCE TEST SET
1	12 KV CAPACITANCE & DISSIPATION FACTOR TEST SET (DELTA 4K)
1	DIGITAL MULTIMETER (DMM)
1	MULTI RATIO CT TESTER (MRCT)
1	INSULATION RESISTANCE TEST SET (SI SERIES)
1	OIL DIELECTRIC BREAKDOWN TEST SET
1	12 KV CAPACITANCE & DISSIPATION FACTOR TEST SET (DELTA 4K)
1	DIGITAL MULTIMETER (DMM)
1	MULTI RATIO CT TESTER (MRCT)



**PPE AND MATERIALS LIST (PER CLASS)**

Issued ea ITEM

1	VOLTAGE DETECTOR (MEDIUM VOLTAGE)
1	DISCHARGE STICK
1 SET	GROUNDING CABLES (BALL TYPE, DALLAS ONLY)
2 PAIR	CLASS 2 RUBBER INSULATED GLOVES WITH GAUNTLETS SIZE 10/11
1	INSULATED QUICK RELEASE GRIP ALL STICK
1 PAIR	SAFETY GLASSES
1	TOOL BOX
1 BOX	SCOTCHBRITE (RED GENERAL PURPOSE)
1 BOX	LINT FREE SHOP TOWELS

**TOOL BOX LIST (PER CLASS)**

1	TOOL BAG/BOX
2	KLEIN MULTI TOOL SCREW DRIVER
1	8" CRESSENT WRENCH
1	8" ADJUSTABLE WRENCH
1 SET	STANDARD OPEN WRENCH
1 SET	METRIC OPEN WRENCH
1	25' TAPE MEASURE
1	6" PRECISION RULER
5	12" STRANDED CU OR AL JUMPERS
1	RECHARGEABLE FLASHLIGHT

FOR VIRTUAL CLASSES:

CONTENT MATERIAL WILL BE PROVIDED IN DIGITAL FORMAT