

Substation Maintenance II

4.5 Days, 3.2 CEUs

This course is the next step after Substation I, which will help enhance the skills needed to perform all substation tasks. It offers training on the components of power and distribution type transformers, including common insulating and cooling mediums, and explains common transformer configurations.

This course is designed to provide an in-depth study to aid skilled qualified substation maintenance technicians in the safe performance of substation component preventive maintenance. This hands-on course is intended for apprentices, technicians, and engineers responsible for the maintenance and testing of industrial and utility substations.

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:

- Obtain required information from a transformer nameplate.
- Perform needed inspections per NETA/MTS.
- Demonstrate and interpret results of required tests performed on transformers.
- Calculate temperature corrections.
- Summarize ASTM requirements for testing and sampling gas and oil in transformers.
- Outline storage battery maintenance.

SCOPE

Day 1* (7 contact hours)

- I. Introduction (0.5 hr)
- II. Introduction to Safety (2.5 hr)
 - A. Lab Safety Rules
 - B. On-the-Job Safety
 - C. General Safety Precautions
- III. Nameplate Data (4 hr)
 - A. Transformer Nameplate
- IV. Labs (3 hrs)
 - A. Nameplate Data Exercises

Day 2 (7 contact hours)

- V. Transformer DC Testing (3 hrs)
 - A. DC Testing
 - B. Insulation Resistance
 - C. Winding Resistance Testing
- VI. Labs (4hrs)
 - A. Transformer Insulation Resistance
 - B. Transformer Winding Resistance Testing (single coil)
 - C. Dual Coil Winding Resistance Test (optional)
 - D. Core Ground Testing (optional)

Day 3 (7 contact hours)

- VII. Transformer AC Testing (3 hrs)
 - A. AC Testing
 - B. Power Factor Testing
 - C. Transformer Bushing Test
 - D. Core Excitation Current Testing
 - E. Turns Ratio Testing
- VIII. Labs (4 hrs)
 - A. Transformer Turns Ratio Testing
 - B. Transformer Power Factor Testing

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

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SCOPE (cont'd)

- C. Transformer Core Excitation Testing
- D. Bushing Testing
- E. Single Phase Turn Ratio Testing (optional)
- F. CT Multi-Tap Testing

Day 4 (7 contact hours)

- IX. Transformer Oil Testing (2 hrs)
 - A. Insulating Liquids
 - B. Liquid Sampling
 - C. Sampling for Gas-In-Oil Analysis
 - D. Silicone Insulating Fluid
 - E. Dielectric Breakdown Voltage Test
 - F. Color Testing

- G. Visual Examination
- H. Neutralization Number Test
- I. Interfacial Tension Test
- J. Moisture Content Test
- K. Liquid Insulating Power Factor Testing
- X. Labs (optional)
 - A. Liquid Insulating Power Factor Testing (optional)
 - B. Oil Dielectric Testing (optional)
- XI. Transformer Gas Testing (2 hrs)
 - A. Gas Detection
 - B. Oxygen Testing
 - C. Combustible Gas Testing
 - D. Gas Analysis Interpretation

- XII. Storage Battery Maintenance (3 hrs)
 - A. Systems and Components
 - B. Applications
 - C. Battery Types
 - D. Battery In-Service Operation
 - E. Effects of Temperature and Duty Cycle on Battery Life
 - F. Battery Safety
 - G. Battery Inspections

Day 5 (Half Day) (4 contact hours)

- XIII. Conclusion
 - A. Review
 - B. Final Test



STANDARD EQUIPMENT LIST

Substation Maintenance II, Course 231 Rev 6

REVISED: 12/14/22

BY: IDA BARAYBAR

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)

Issued ea	ITEM
1	Substation Maintenance II course book, Course 2331, Rev 6, Dec 2022

MATERIALS NEEDED (PER CLASSROOM)

Issued ea	ITEM
*1	PROJECTOR OR TV WITH PROJECTION CAPABILITIES
*1	DRY ERASE BOARD WITH MARKERS AND ERASER
*10	STUDENT TABLES
*10	STUDENT CHAIRS

CLASSROOM MATERIAL (PER STUDENT)

Issued ea	ITEM
1	No. 2 MECHANICAL PENCIL
1	12" CLEAR RULER
1	CALCULATOR

TESTING EQUIPMENT (PER CLASS)

Per class	ITEM
1	10 kV INSULATION RESISTANCE TESTER
1	TRANSFORMER TURN RATIO TESTER (TTR)
1	STATIC DISCHARGE STICK (60/80 KV TO MATCH OVERPOTENTIAL TESTER)
1	TRANSFORMER OHMMETER
1	VOLTAGE DETECTOR (MEDIUM VOLTAGE)
1	STATIC DISCHARGE STICK (60/80 kV)
1	670511 OIL TEST CELL
1	RUBBER BLANKET
1	MEGGER MRCT TESTER

PERSONAL PROTECTIVE EQUIPMENT (PER STUDENT)

Issued ea	ITEM
2/CLASS	TESTED, CLASS 4, GLOVES (SIZE 9, 10, and 11)
1	SAFETY GLASSES

TOOLS AND SUPPLIES (PER CLASS)

Per class	ITEM
1	STANDARD SAE TOOL BOX
1	PACKAGE OF LINT FREE TOWELS
1	PACKAGE OF RED SCOTCH BRITE

FIXED EQUIPMENT (PER CLASS)

Per class	ITEM
*1	THREE PHASE 500 kVA (MINIMUM) LIQUID FILLED TRANSFORMER (PREFER TAPPED PRIMARY AND SECONDARY) W INSTRUCTION MANUAL
*2	CONDENSER BUSHINGS

FOR VIRTUAL CLASSES:

CONTENT MATERIAL WILL BE PROVIDED IN DIGITAL FORMAT