

# Cable Testing and Diagnostics, Medium Voltage

4.5 Days, 3.2 CEUs

Medium voltage cable systems are the backbone of electrical systems worldwide, yet often they are the most ignored part of the power system – **until there is a failure**. Cable systems today have higher failure rates than ever before due to aging, environmental stresses and improper installation. While the ability to efficiently locate faults can greatly reduce downtime, an effective cable testing program can help technicians in prioritizing cable repair prior to failure. This helps prevent unplanned outages, equipment damage and electrical accidents and ultimately reducing costs.

This hands-on course is intended for new or experienced electricians and technicians that install, maintain, repair or troubleshoot 5-35 kV solid dielectric power cables.

The student should have some field experience and basic knowledge of AC/DC electricity.

## 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, the participant 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 and 50% final exam). Upon completion of this course and lab practice, the participant will demonstrate that he/she is able to:

- Identify medium voltage cable components and causes of failure.
- Utilize safe work practices for cable testing per OSHA and industry consensus standards.
- Interpret current industry cable testing standards and procedures.
- Perform and analyze results of:
  - Insulation Resistance Tests (DAR and PI).
  - Withstand Tests (DC, AC & VLF).
  - Diagnostic Field Tests (Tan Delta & PD).
- Outline the benefits gained by establishing a Conditioned Based Cable Maintenance Program.

## SCOPE

<p><b>Day 1* (7 contact hours)</b></p> <p>I. Introduction (0.5 hours)</p> <ol style="list-style-type: none"> <li>A. Schedule</li> <li>B. Course outline</li> </ol> <p>II. Introduction To Medium Voltage Cable Testing (1.5 hr)</p> <ol style="list-style-type: none"> <li>A. Purpose of Power Cables</li> <li>B. Cable Components &amp; Operation</li> <li>C. Cable Insulation</li> <li>D. Types of Tests Performed on Medium Voltage Cables</li> <li>E. General Guidelines for Cable Testing Safety</li> </ol>	<p>AM Break</p> <p>III. Cable Testing Standards (2 hr)</p> <ol style="list-style-type: none"> <li>A. Institute of Electrical and Electronics Engineers (IEEE)</li> <li>B. National Fire Protection Association (NFPA)</li> <li>C. International Electrical Testing Association (NETA)</li> <li>D. Association of Edison Illumination Companies</li> <li>E. Insulated Cable Engineers Association (ICEA)</li> <li>F. American National Standards Institute (ANSI)</li> </ol>	<p>G. American Society for Testing of Materials (ASTM)</p> <p>H. International Electro-Technical Commission (IEC)</p> <p>I. International Council on Large Electrical Systems (CIGRE)</p> <p>Lunch</p> <p>IV. Insulation Resistance Testing (IR) (3 hrs)</p> <ol style="list-style-type: none"> <li>A. Safety Precautions</li> <li>B. Theory of Test</li> </ol> <p>PM Break</p> <ol style="list-style-type: none"> <li>C. Evaluating Resistance Measurement</li> </ol>
--	---	--

\*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

# Cable Testing and Diagnostics, Medium Voltage

4.5 Days, 3.2 CEUs

## SCOPE (continued)

### Day 2 (7 contact hours)

- V. Field Tests (Withstand Tests) ..... (4 hrs)
  - A. Safety Precautions
  - B. Voltage Withstand Tests
  - C. Alternating Current (AC Line Frequency) Withstand Test
  - D. Very Low Frequency (VLF) Withstand Test
  - E. Test Equipment Connections
  - F. Direct Current (DC) Withstand Test
- AM Break
- G. Current Avalanche
- H. Other Unusual Currents
- I. Ionization Control
- J. Voltage Regulation
- K. Insulation Resistance
- L. Testing Intervals and Values
- Lunch
- VI. Field Tests (Withstand Tests) ..... (3 hrs)
  - A. D.A.R., P.I. and I.R. labs
- PM Break
- B. V.L.F. Withstand testing lab
- C. D.C. Withstand testing lab

### Day 3 (7 contact hours)

- VII. Field Tests (Diagnostics Tests).... (7 hours)
  - A. Dissipation Factor Testing
  - B. Analyzing Tan Delta Test Results
- AM Break
- C. Test Area Safety
- D. Interpreting Test Data
- E. Technical Analysis
- Lunch
- F. PD Test Equipment Set-Up
- G. Interpreting Test Data
- PM Break
- H. Other Cable Tests
- I. Shield Testing
- Day 4 (7 contact hours)**
- VIII. Testing Labs (7 hours)
  - A. VLF Tan Delta lab
- AM Break
- A. VLF Tan Delta lab (cont'd)
- Lunch
- B. Partial Discharge lab
- PM Break
- B. Partial Discharge lab (cont'd)

### Day 5 (4 contact hours)

- IX. Condition Based Maintenance of Medium Voltage Cables "Notes from Underground" (3 hrs)
- AM Break
- X. Conclusion (1 hr)
  - A. Review
  - B. Final Test



**STANDARD EQUIPMENT LIST**  
**Cable Testing & Diagnostics Medium Voltage**  
 Course Number 131, Rev 3

REVISED: November 2017

BY: Mark Franks

DAYS: 4.5 DAYS

<b>TEXT ( PER 1 STUDENT)</b>	
<b>QUANTITY</b>	<b>ITEM</b>
1	CABLE TESTING & DIAGNOSTICS, MEDIUM VOLTAGE REV .3, NOV 2017

<b>MATERIALS NEEDED (PER CLASSROOM)</b>	
<b>QUANTITY</b>	<b>ITEM</b>
*1	PROJECTOR OR TV WITH PROJECTION CAPABILITIES
*1	DRY ERASE BOARD WITH MARKERS AND ERASERS
*10	STUDENT TABLES
*10	STUDENT CHAIRS

<b>EQUIPMENT (PER STUDENT)</b>	
<b>QUANTITY</b>	<b>ITEM</b>
1	MEGGER VLF SIN 45 WITH LEADS AND MANUAL
1	COMPUTER WITH PDS 60 SOFTWARE AND HARDWARE KEY AND MANUAL
1	MEGGER 70 KV DC DIELECTRIC TEST SET WITH LEADS AND MANUAL
1	MEGGER TELEFLEX TIME DOMAIN REFLECTOMETER WITH LEADS AND MANUAL
1	MEGGER 10 KV MODEL MIT 1025 INSULATION RESISTANCE TESTER WITH LEADS AND MANUAL
1	MEGGER TDS NT PARTIAL DISCHARGE TEST SET W/HV FILTER, LEADS, MANUAL

<b>DEVICES (PER CLASS)</b>	
<b>QUANTITY</b>	<b>ITEM</b>
2	RUBBER GLOVES SIZE 10
2	BIDDLE GROUNDING STICK
1 Lot/Class	BARRIER (DALLAS ONLY)
1 Lot/Class	BARRIER CONES (DALLAS ONLY)
2	25 FT EXTENSION CORDS
1	CLASS 4 SALISBURY RUBBER BLANKET
2	3 PHASE URD GROUNDING SETS S
2	LIVE LINE TOOL (SHOT GUN STICK)
2	HARD HAT AND FACE SHIELD

6	15 KV JUMPERS WITH ELBOWS
3	15 KV FEED THROUGH DEVICES
6	15 KV PARKING STANDS
1	PENTA SOCKET & RATCHET TOOL
6	ELBOW TEST PROBES
1	ELBOW PULLER
1	HV ELBOW CONNECTOR FOR TDS NT

<b>A/V Equipment (PER STUDENT)</b>	
<b>QUANTITY</b>	<b>ITEM</b>
1	SAFTEY GLASSES

FOR VIRTUAL CLASSES:  
 CONTENT MATERIAL WILL BE PROVIDED IN DIGITAL FORMAT

NOTE: All items indicated with an asterisk (\*) must be supplied by the client on On-Site courses