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# Medium Voltage Cable Testing Training

Course details: <https://electricityforum.com/electrical-training/power-cable-testing-training>

## COURSE DATES AND TIMES

Medium Voltage Power Cable Testing - Our 12-hour live online instructor-led training course is designed for electrical engineers, electrical technicians, and front-line electrical testing and maintenance specialists who test, install, maintain, repair, or troubleshoot medium and high voltage power cables\*. Since power cables are the backbone of the worlds power distribution system, many must learn how cable systems are designed, installed, and tested, as well as the applicable Standards to follow, and how to properly select and perform the appropriate testing methods for their situation.

Students will learn of the various methods used to perform mostly off-line cable testing. An overview of all the numerous possible tests available will be offered, followed by a more detailed, comprehensive study of the most prominent technologies and test methods used today. They will learn how to perform and analyze results of insulation resistance tests (DAR & PI), DC hipot tests, Type I withstand tests (DC, AC, & VLF), and diagnostic testing using Tan Delta and Partial Discharge techniques.

Except for Installation over-voltage withstand testing of newly installed systems, most MV/HV cable testing is Diagnostic, or non-destructive, using absolute, trending, and comparative test data usually performed as part of a condition-based electrical maintenance program. Although all methods of cable testing will be explored, our course focuses on the current methods of Withstand, Tan Delta, and Partial Discharge testing using VLF and 50/60 Hz. power frequency techniques for data collection to provide specific defect information and/or the overall condition of the cable.

After attending this course, students will know how to:

- Consider the various testing options available
- Select the methods best suited for their application
- Specify the equipment needed
- Perform the tests
- Collect the data and analyze the results
- Assess the health of the cables tested

\* This course is mostly for testing of medium voltage cables, but most of the methods and technologies described are used on HV cable up to ~200 kV in rating.

### **WHO SHOULD ATTEND**

- Electric Utility Engineering and Maintenance Personnel
- Industrial, Commercial, Institutional Electrical Engineering and Maintenance Personnel
- Electrical Consulting Engineers
- Electrical Design Engineers

### **STUDENTS RECEIVE**

- FREE 100-Page Digital Wire And Cable Handbook (Value \$20)
- \$100 Coupon Toward Any Future Electricity Forum Event (Restrictions Apply)
- 1.2 Continuing Education Unit (CEU) Credits
- 12 Professional Development Hours
- FREE Magazine Subscription (Value \$25.00)
- Course Materials In Paper Format

### **COURSE OUTLINE**

#### **MV-HV Cable Testing Training Course Outline**

#### **DAY ONE**

##### **Cables and Cable Systems Described**

- Explanations & Definitions of components
- Cable voltage ratings and insulation materials defined
- Various insulation types commonly used

##### **Why Do We Test Medium and High Voltage Cable**

- Why do we need to test new cable systems
- Why do we need to test old cable systems
- Why do cables and the attached accessories fail
- What are the aging/deterioration mechanisms
- What are the most common reasons for failures

## **OK, We'll Test. What Are We Looking For**

- Depending on test method many different results occur
- Different data sets reveal different weaknesses
- Obvious pass/fail results from some test methods
- Interpretation of test data required of other tests

## **How to Select Best Method to Use: Different Tests = Different Results**

- What's your cable system design: radial, network, loop...
- How long are the cables: need a portable hipot or multi-ton resonant system
- What do you want to learn from the tests
- What repair/replacement methods are available, practical, & economical
- What performance criticality can you live with

## **Commonly Used Methods for MV/HV Cable Testing**

- Soak Test: AC Line Voltage with No Load for 24 Hours
- Insulation Resistance (IR) Measurement: DC Voltage  $< 1U_0$
- Leakage Current, or Hipot, Test: DC Over Voltage  $> 3U_0$
- AC Withstand Test: AC Over Voltage @ 50/60 Hz. Power Frequency  $> 2U_0$
- Partial Discharge AC Over Voltage Measurement:  $< 2U_0$
- Tan Delta AC Over Voltage Testing:  $< 2U_0$
- Very Low Frequency AC Withstand Test: 0.10 Hz.  $< 3U_0$
- VLF Partial Discharge Over Voltage Test: 0.10 Hz. @  $< 2U_0$
- VLF Tan Delta Over Voltage Test: 0.1 Hz. @  $< 2U_0$
- Oscillating Wave Partial Discharge Test: 20 – 200 Hz
- Other Rare Esoteric Tests Seldom Used

## **DAY TWO**

### **Brief Review of Cable Testing Methods & Technologies Available**

- Soak Test: AC Line Voltage with No Load for 24 Hours
- Insulation Resistance (IR) Measurement: DC Voltage:  $< 1U_0$
- Leakage Current, or Hipot, Test: DC Over Voltage:  $> 3U_0$
- AC Withstand Test: AC Over Voltage @. Power Frequency:  $> 2U_0$
- Parallel or Series Resonant Systems:  $> 2U_0$
- Partial Discharge AC Over Voltage Measurement:  $< 2U_0$
- Tan Delta AC Over Voltage Testing:  $< 2U_0$
- Very Low Frequency AC Withstand Test: 0.10 Hz.  $< 3U_0$
- VLF Partial Discharge Over Voltage Test: 0.10 Hz. @  $< 2U_0$
- VLF Tan Delta Over Voltage Test: 0.1 Hz. @  $< 2U_0$
- Oscillating Wave Partial Discharge Test: 20 – 200 Hz

- Other Rare Esoteric Tests Seldom Used

## **Technologies & Methods Taught in This Course**

- Very Low Frequency AC Testing: 0.10 Hz. – 0.01 Hz.
- VLF Overvoltage Withstand Testing: Pass/Fail
- VLF Diagnostic Testing: Tan Delta & Partial Discharge

## **VLF Overview, History, and Acceptance**

- What is VLF?
- Why Use VLF?
- What Loads is VLF used to test?
- Where is VLF not used?
- When was VLF used en masse?
- Development History
- Is 0.10 Hz. similar enough to 50/60 Hz?
- Are all VLF Designs from various vendors the same?

## **VLF Testing Standards**

- IEEE Standards
- Medium Voltage Cable Testing: Withstand & Diagnostics
- Rotating Machinery Testing (motors & generators)
- Other Standards or Recommendations for Medium Voltage Cable Testing
- NETA, ANSI, ASTM, IEC, ICEA, etc.
- HV Cable Testing Standards/Recommendations

## **VLF Withstand & Diagnostic Tests – Which to perform? What is the Desired Result?**

- Acceptance/Proof/Commissioning via over voltage withstand test
- What is the test, what are the rules, how do we do it?
- Apply over voltage per standard up to 3  $U_0$  – cable holds voltage or fails
- If failed, now what? Repair or replace?
- Repair: Locate fault precisely if to be dug up with repair to be made
- Replace: Locate fault approximately to replace section with new cable

## **VLF Tangent Delta Test – How Good is my Cable Overall? Global Assessment**

- Used to determine the extent of insulation degradation
- Over-voltage applied to cable of  $< 2 U_0$
- Voltage & Current waveforms captured and analyzed
- Phase shift from ideal 90° measured
- TD value produced and used for analysis and comparison
- Is cable Good, Requires Further Study, or Needs Replacement?

## **Partial Discharge Test – Where are the bad spots? Specific Location and Severity**

- Used to locate defects emitting electrical noise (pd) and their locations
- Over-voltage applied to cable of  $< 2 U_0$
- Voltage raised: Partial Discharge Inception Voltage (PDIV) Measured
- Voltage lowered: Partial Discharge Extinction Voltage (PDEV) measured
- PD voltage levels, quantity, and locations analyzed
- Are PD points severe and need repair or less worrisome – just monitor?

## **Summary**

- Summary of Withstand, TD, and PD Testing.
- Differences in Results Revealed, Ease of Use, Availability, Cost, etc.
- When to Use Which Technology. PowerPoint of all VLF, TD, PD Models

## **Review of Expectations Questions and Answers**

## **COURSE TIMETABLE**

### **Both days:**

Start: 10 am ET

Finish: 4:30 pm ET

Contact us Today for a FREE quotation to deliver this course at your company's location.

<https://electricityforum.com/onsite-requestforquote>