



Learning Resources

On-Demand Training

45-Minute and 4-Hour Courses

NETA – the InterNational Electrical Testing Association is committed to leading the electrical power industry through education; standards development; accreditation of independent, third-party testing organizations; and certification of test technicians.

The **NETA Learning Resources Library** provides industry professionals with access to over 100 training courses that will increase their knowledge, assist them in maintaining or training for advanced certification examinations, and overall career advancement.

The On-Demand series offers professionals access to high powered learning from anywhere, at any time. These 45-minute sessions and 4-hour seminars are designed for flexible training and earning industry credits.

All content is eligible to be submitted for NETA CTD credits (CTDs) and/or Continuing Education Units (CEUs).

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45-Minute and 4-Hour Courses

Available Courses

45-Minute Sessions – Acceptance Testing

- *Acceptance Testing PV Generation Sites*
David Morrissey, Asplundh Engineering

45-Minute Sessions – Cables

- *Advantages and Disadvantages of Very Low Frequency and Tan Delta Testing*
Charles Nybeck, Megger
- *Power Cable System Reliability and Longevity*
Ben Lanz, IMCORP – Power Cable Reliability
- *Test Setup Issues Impacting SFRA Results*
Mike Anderson, Doble Engineering Company
- *NETA MTS Update on Cables*
Chasen Tedder, Hampton Tedder Technical Services
- *Non-Destructive Partial Discharge (PD) Diagnosis of Medium Voltage Power Cables*
Jason Aaron, Megger
- *Understanding Tan Delta Testing*
Tom Sandri, Protec Equipment Resources

45-Minute Sessions – Case Studies

- *Medium-Voltage Equipment Installation: What You Don't Know CAN Hurt You*
Mike Bryan, Hood Patterson & Dewar
- *State of the Electrical Testing Sector*
Paul Seppanen, A-Rent Test Equipment
- *On-line Leak Repair – Oil, SF₆ and Nitrogen Leaks*
Gary Brown, The COLT Group
- *Service Life Extension to Vacuum Interrupters: Case Studies Highlighting Technology and Techniques in Vacuum Interrupter Conditioning (VIC)*
Finley Ledbetter, Group CBS
- *Driving Employee Engagement and Retention with Career Path Opportunities in the Electrical Testing Field*
Chris Campbell, CE Power Engineered Services
- *Testing a Protection Relay as a "Black Box": Systems Testing Explained*
Will Knapek, OMICRON electronics Corp USA
- *Dos and Don'ts of Power Factor Testing*
Dinesh Chhajer, Megger
- *Real World Power Quality Monitoring Applications & Analysis*
Ross Ignall, Dranetz

45-Minute and 4-Hour Courses

- *Creating a Comprehensive Employee Development Program: A Case Study*
Stehpanie McLaughlin, Hood Patterson & Dewar, Inc.

45-Minute Sessions – Circuit Breakers

- *Circuit Breaker Testing and Diagnostics – A Review*
Charles Sweetser, OMICRON electronics Corp. USA

45-Minute – Equipment Reliability

- *Ground Test Screening*
Kenneth Peterson, Hampton Tedder Technical Services
- *Testing Electric Motors Using NETA Testing Standards – What You Need to Know*
Calvin Earp, Shermco Industries
- *Switch On to Fault*
Ryan McDaniel, Schweitzer Engineering Laboratories, Inc.
- *Interpretation of Online Partial Discharge Phase Resolved Patterns and Waveform Captures*
Timothy Erwin, EA Technology
- *Partial Discharge Detection Using UHF*
Bill Higinbotham, EA Technology
- *Advanced Power Factor Analysis of Transformers and Bushings*
Charles Sweetser, OMICRON electronics Corp. USA
- *Asset Health Indices for Substation Equipment*
Albert Livshitz, Saber Power
- *Directional Protection and Testing*
Sughosh Kuber, Megger
- *Equipment Reliability: How Do You Get It and Keep It*
Stephan Hester, Saber Power
- *Field Assessment of Rotating Machine Insulation Using DC and AC Test Methods*
Abel Gonzales, Megger
- *Filling in the Testing Gaps on Auxiliary Equipment*
Josh Vareberg, TRC Companies, Inc.
- *A Review and Analysis of Current Protection Testing Practices*
Scott Cooper, OMICRON electronics Corp. USA
- *Capacitor Bank Diagnostics*
Ben Clark, RESA Power Service
- *PdMAEYE – Continuous Monitoring*
Noah Bethel, PdMA Corporation
- *Electrical and Current Signature Analysis of Power Systems*
Howard Penrose, MotorDoc, LLC

45-Minute and 4-Hour Courses

45-Minute Sessions – Relay

- *The Importance of Overexcitation (V/Hz) Protection for Power Transformers and Generators*
Drew Welton, Intellirent
- *When to Repair/Replace/Upgrade Electromechanical Relays*
Bruce Horowitz, American Electrical Testing Co., LLC
- *Electromechanical Differential Relays Misoperation and Investigation*
Alex Rangel, Saber Power Services
- *Testing Philosophy: Past, Present, and Future*
Scott Cooper, OMICRON electronics Corp. USA
- *How CT and VT Connection Errors Affect Protection*
Karl Zimmerman, Schweitzer Engineering Laboratories, Inc.
- *Implications of an Improperly Installed On-Load Tap-Changer and Protection Considerations*
Alex Rangel, Saber Power Services
- *Testing Protection Systems in the Real World: Challenges and Recommendations*
Guillermo Falquez, Megger
- *Induction Motor Protection Testing*
Abel Gonzales, Megger
- *Testing Motor Protection Relays*
Drew Welton, Intellirent
- *Testing the Right Stuff: Using Data to Improve Relay Availability, Reduce Failures, and Optimize Test Intervals*
Derrick Haas, SEL

45-Minute Sessions – Sales and Management

- *Developing a NETA Engineer*
Kevin Maynard, Potomac Testing
- *Successfully Market your Electrical Testing Services Firm*
Paul Seppanen, A-Rent Testing Equipment
- *Difference Between Group and Team*
Kenneth Peterson, Hampton Tedder Technical Services
- *The Effects of Relationship Management on the Follower*
Kenneth Peterson, Hampton Tedder Technical Services

45-Minute Sessions – Safety

- *Safety Management: Risk Assessments and the Risk Management Process*
Stephen Hester, Saber Power Services
- *How Attitude Can Affect Job Safety*
Jim White and Jeremy Presnal, Shermco Industries

45-Minute and 4-Hour Courses

- *Are We Overlooking Hazards? Do We Know How to Respond to an Emergency?*
Andrew Holt, Premier Power Maintenance Corporation
- *Changing Codes for a Changing World*
Kevin Maynard, Potomac Testing, Inc.
- *Incident Avoidance by Ground Grid Testing*
Keith Wallace, Safeearth
- *A New Approach to Safely Testing Common Circuits in a Substation Environment*
Tim Walker, OMICRON electronics Corp. USA
- *Risk Assessment and the Risk Management Process*
Stephan Hester, Saber Power
- *Near-Misses and Your Safety program: Are You Really a Learning Organization*
Stephan Hester, Saber Power
- *Believe in Safety*
Brandon Schroeder
- *Hazardous Energy Control: Common Pitfalls & How to Mitigate (Part 2)*
Jeremy Presnal, Shermco Industries
- *Electrical Safety – Opening a Can of Worms and Being Safety Conscious*
Jonathan Dyer, ECP Solutions
- *NFPA 70E: Critical Aspects and Revision Updates*
Jim Dollard, IBEW Local 98
- *Reducing Incidents through Good Catches*
Mark McKeon, Electrical Reliability Services
- *De-Centralized Operational Approach to Safety and Human Performance in Organization*
Morteza Talebi, TRC Companies, Inc.

45-Minute Sessions – Transformers

- *Comparison Between Dielectric Frequency*
Sanket Bolar, Megger
- *Transformer Insulation Condition Assessment: The Evolution of Diagnostic Testing*
Jason Aaron, Megger
- *Capacitive Voltage Transformer Testing Practice and Field Challenges*
Joseph Aquirre, Megger
- *Transformer Windings Condition Assessment*
Daniel Carreno, Megger
- *Bushing Condition Assessment: What You Don't Know Really Can Hurt you*
Volney Naranjo, Megger
- *Partial Discharge of Electrical Assets: What Are My Options and What Value Does It Provide*
Charles Nybeck, Megger

45-Minute and 4-Hour Courses

- *Protection Considerations for a Transformer with an XO Left Disconnected*
Alex Rangel, Saber Power
 - *Importance of Testing SF6 Contaminants*
Justin Palmer, GasQuip
 - *Wind Turbine Transformers and Bushing Failures*
Ben Clark, RESA Power Service
 - *Field Testing of Current Transformers: Challenges and Mitigation Techniques*
Dinesh Chhajer, Megger
 - *Common Mistakes Made When Setting up for Power Factor Testing of Transformer/Transformer Brushings*
Chad Brown, Doble Engineering Company
 - *Performing Power Factor Frequency Sweeps and Voltage Sweeps on Transformers*
Brandon Dupuis, OMICRON electronics Corp. USA
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4 Hour Seminars – Cables

- **A Comprehensive Strategy for Low and Medium Voltage Cable Fault Location**
Presented By: Tom Sandri, Shermco Industries

The mere mention of cable fault location sends shivers down many a spine. This seminar will review cable fault locating techniques, their strengths and weaknesses and build a comprehensive strategy for fault location on both low and medium voltage cables.

- **Partial Discharge Testing of Medium Voltage Cables: Online and Office Technologies**
Presented By: Tom Sandri, Protec Equipment Resources

This seminar reviews popular MV cable diagnostic technologies, explains why the partial discharge (PD) test is an effective tool to diagnose MV cables, and summarizes typical PD test sensors used in onsite MV cable diagnosis. Interpreting data from onsite PD tests is also discussed because data interpretation is critical to achieving the expected advantages of PD tests. Topics will include:

- **Background on Cable Installation and Insulation Types**
- **Cable Construction**
- **Aging and Deterioration**
- **Testing Options Beyond PD**
- **Standards Associated with PD Testing**
- **Parameters Typically Measured During a PD Test**
- **Data Interpretation**

- **Test Methods & Data Analysis of MV Power Cables**
Presented By: Jason Aaron, Megger



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45-Minute and 4-Hour Courses

This seminar will discuss and demonstrate proper testing techniques, application and result analysis for VLF, tan delta and offline partial discharge tests performed on MV cable systems. Additionally, we will cover a methodical approach to cable testing to improve efficiency and avoid pitfalls that impact productivity. Proper data analysis to improve cable system reliability will also be discussed.

4 Hour Seminars – Case Studies

- **Technology for Building a Successful NETA Accredited Company**

Presented By: Matthew Ellis, Sentinel Power Services, Inc.

The seminar outlines how to implement systems, train personnel, and garner support from management throughout the organization while identifying possible pitfalls. The generalized cost analysis and how to determine licensing, budgeting, and scaling will be covered in the information provided.

- **Transformer Testing Theory and Case Studies Seminar**

Presented By: Mike Anderson, Doble Engineering

This seminar will briefly review the theory and data interpretation of common transformer tests, including dielectric, excitation, turns ratio, and winding resistance, then shifting to the presentation of real-world case studies, providing examples of both fault and non-fault related issues that can impact test data.

- **Doing Right Things for Right Reasons**

Presented By: Tim Autrey, PPI Global

- **NETA Certification: Prepare for Success**

Presented By: Jim Cialdea, CE Powered Engineer Services, and Dan Hook, Group CBS

4 Hour Seminars – Circuit Breakers

- **A to Z Circuit Breaker Testing**

Presented By: Volney Narango and Sanket Bolar, Megger

This seminar will cover the tests that can be done for maintenance of circuit breakers. For low voltage circuit breakers, primary injection testing will be covered. It will cover the various types of primary injection tests and the challenges faced while doing primary injection testing.

- **Low Voltage Circuit Breaker Modernization**

Presented By: Brian Bianchi, utility Relay Corporation



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45-Minute and 4-Hour Courses

The course combines classroom instruction and hands-on experience to provide new and veteran technicians alike with a solid understanding of the trip unit retrofit process.

Attendees should have basic knowledge of AC and DC electricity and be familiar with low voltage circuit breakers. Students will learn about the different types of LV circuit breakers and the evolution of protective technology, ranging from series overloads to modern day microcontroller-based trip units.

The course will go into detail on actuator and CT fundamentals; how to read and understand time-current curves (TCCs); the different types of offered protection (LSIG and maintenance settings); basics of device coordination; modern trip unit features such as arc flash mitigation, communications, and mechanism time measurements; how to prepare breakers for upgrade; and secondary injection testing and commissioning of the retrofitted circuit breaker.

- **NETA Breaker Maintenance, Life Extension**

Presented By: Finley Ledbetter, Group CBS, Inc.

This presentation will focus on the benefits and best practices of circuit breaker maintenance and life extension programs. With good, regular circuit breaker maintenance, most metal-clad electrical apparatus will last far beyond their 20-year design plan, working safely and efficiently in power distribution systems for 30, 40 years, and even longer. At the same time, life extension programs can extend the useful life of your breakers (and switchgear, and motor controls, etc.) that may be considered functionally obsolete for the existing application. Some of the breaker maintenance practices discussed in this presentation include how to conduct visual inspections, mechanical verification checks, electrical testing, and the benefits of repairing and reconditioning low-, medium-, and high-voltage circuit breaker apparatus, among others. Additionally, the presentation will talk about how's and why's of life extension programs, including retrofits and retrofills.

4 Hour Seminars – Equipment Reliability

- **Partial Discharge Testing of Electrical Equipment: Implementing Existing Technologies and Methods**

Presented By: Tom Sandri, Shermco Industries

- **Hands-On Battery Maintenance and Testing**

Presented By: Thomas Sandri, Protec

Stationary batteries used in substations are critical components because they are relied upon as the main source of power by several equipment systems in the event of an outage. It is important to monitor battery health to ensure a reliable backup source of power. This seminar is designed to educate the attendees on standards and practices for battery maintenance.

45-Minute and 4-Hour Courses

- **Developing an Electrical Workforce**

Presented By: Thomas Sandri, Protec

- **Vacuum Interrupter Conditioning**

Presented By: Finley Ledbetter, Group CBS

4 Hour Seminars – Maintenance Testing

- **Electrical Testing and Maintenance of Rotating Machines**

Presented By: Abel Gonzalez, Megger

The condition of a rotating machine can be evaluated by using a combination of Static and Dynamic testing techniques. Static tests are performed while the motor is disconnected from the system, typically during manufacturing, commissioning, maintenance, or repairs. The goal of Static tests is to provide a proper picture of electrical characteristics of the machine.

4 Hour Seminars – Partial Discharge Testing

- **What's Involved in a Complete Partial Discharge Program**

Presented By: Bill Higinbotham, EA Technology

Topics covered:

- Background PD information
 - How to do PD testing
 - Baseline, periodic, and opportunistic testing
 - Online versus offline
 - How to react to test results
 - Synergy with other tests
 - Fulltime monitoring
 - Data handling for results and trending
 - Relating results to probability of failure
 - Using consequence of failure to monetize risk.
 - Integrating with Enterprise Asset Management systems
 - Training of personnel involved.
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Learning Resources On-Demand Training

45-Minute and 4-Hour Courses

4 Hour Seminars – Relays

- **Relay Troubleshooting**

Presented By: Ryan McDaniel, Schweitzer Engineering Laboratories

Want to know some basics about troubleshooting application problems with protective relays? This half-day session will guide you through troubleshooting techniques using common distribution, transformer, and motor protection relays.

- **Help! My customer is Asking About Digital Substation Testing**

Presented By: Scott Cooper, OMICRON

Digital relays continue to revolutionize relay protection by increasing sensitivity, security, and near-term reliability. The next step in this revolution is the digital substation which, in simplest terms, replaces copper protection and control wiring with devices that communicate using a specialized protocol via an ethernet network. Of course, this new type of substation requires new knowledge as well as specialized tools to commission, test and troubleshoot them.

- **Relay Troubleshooting Part 1 and Part 2**

Presented By: Ryan McDaniel, Schweitzer Engineering Laboratories, Inc.

4 Hour Seminars – Sales and Management

- **Hands on: Creating a Comprehensive Employee Development Program**

Presented By: Stephanie McLaughlin, Hood Patterson & Dewar, Inc.

- In this companion workshop to the Creating a Comprehensive Employee Development Program: A Case Study training session, learners will have a chance to apply these processes to their own companies. Stephanie will provide step-by-step guidance for getting started so that learners can begin to apply these principles in creating their own employee development programs. Learners will also be given the opportunity to identify the components of an employee development program that may apply to their organizations and create an action plan for moving forward in designing their own programs while identifying the next steps in that process.

- **Exam Seminar Part 1 and Part 2**

Presented By: Dan Hook, CBS Field Services

4 Hour Seminars – Safety

- **How Smart Workers use Situational Awareness to Improve Safety**

45-Minute and 4-Hour Courses

Presented By: Richard Gasaway, Situational Awareness Matter

Strong situational awareness is an important aspect of worksite safety. This session, you will learn how situational awareness is developed and maintained, as well as best practices to improve situational awareness in the workplace.

- **Cyber Security: The Effects on NETA Companies, Safety Programs, and Clients**

Presented By: Matthew Ellis, Sentinel Power Services

New compliance standards, insurance requirements, client requirements, contract amendments, and a host of new and necessary practices are proliferating and evolving to combat the future of cyber-attacks, information theft, and cyber terrorism. This Seminar intends to educate everyone from any background on those practices: how cyber security works, how hackers and criminals operate in the cyber realm, and how to identify and expect the upcoming changes in contracts and site work, the changes in compliance group requirements, the governance and use of industrial facility networked equipment, and how to harden workstations and servers within the company while providing security to any employee that is on site, at their home base, in their personal home office, and beyond to meet compliance standards set forth by customers and contracts.

- **Infrared Thermography for Electrical System Maintenance – How to Ensure Accuracy, Safety, and Reliability**

Presented By: Jim Seffrin, Infrasppection Institute

This four-hour course is a must for anyone who performs infrared inspections of electrical systems for the purpose of Preventive/Predictive Maintenance or Quality Assurance.

Learning outcomes

- recognize various uses of infrared imaging for electrical systems
- select thermal imaging equipment appropriate for any infrared inspection
- improve inspection findings and temperature measurement accuracy
- prioritize exceptions utilizing published engineering standards
- apply temperature limits to operating electrical components
- ensure compliance with published standards for infrared inspection reports

4 Hour Seminars – Transformers

- **Primer on Transformer Diagnostic Testing**

Presented By: Brandon Dupuis and Charles Sweetser, OMICRON

The seminar focuses on the diagnostic testing that can, and should, be performed during regular maintenance intervals, to ensure that the transformer is in good condition, and can continue its in-service duty with minimal risk.

45-Minute and 4-Hour Courses

- **Frequency Based Diagnostic Testing of Power Transformers**

Presented By: Dinesh Chhajer and Diego Robalino, Megger

For this seminar, presenters will focus on the best practices to perform Sweep Frequency Response Analysis (SFRA) and Dielectric Frequency Response (DFR) testing in field and factory. Through case studies the agenda will cover main applications and interpretation of results of advanced frequency-based diagnostic techniques, namely SFRA and DFR.

- **Testing and Commissioning of Instrument Transformer in the Field**

Presented By: Morteza Talebi, TRC Companies

Instrument transformers measure and transform high current and voltage magnitudes in the transmission and distribution system to low and more manageable secondary magnitudes that are used to supply intelligence to metering, monitoring, and protective control equipment. The purpose of this training is to provide a general overview of instrument transformers and the required tests for ensuring the serviceability of substation current transformers and voltage transformers. Topics include Current and Voltage Transformer theory and application, nameplate interpretation, current and potential transformer stand alone and circuit testing and precautions in field testing of Instrument transformers.

- **Testing and Commissioning of Current Transformer Circuit in the Substation: Different Practice Among Us Utilities**

Presented By: Morteza Talebi, TRC Companies

There have been many incidents and outage reports in our industry caused by protective relay mis-operation during normal load conditions or not operating during the fault condition. Causes for this might be incorrect phasing and polarity of CTs, excessive burden on CT's secondary, CT's wiring error, shorted CTs in the CT's shorting block, spurious CT's circuit ground, loose ground, or multiple ground and open circuited CT under the load. All of these prove the importance of doing the correct CT tests before putting back to the service very important. This presentation provides a theory and simple explanation of the common practices used for correct CT circuit testing among U.S. utilities and compares the benefits and drawbacks of each method for commissioning engineers and protective relay technicians. These methods include current transformer primary and secondary injection test, light bulb test, high impedance test, and through fault test.

- **Transformer Off-Line Testing and Analysis**

Presented By: Mike Anderson, Doble Engineering Company

This training course combines theoretical background with practical field experience to provide engineers, managers, and technicians with fundamental knowledge regarding the theory, test setup, and diagnostic analysis associated with transformer off-line electrical testing. The course will culminate in the application of the information discussed to real-world case studies, showing the impact of both fault and non-fault related issues on transformer test results.

45-Minute and 4-Hour Courses

- **Understanding Transformer Protection**

Presented By: Finley Ledbetter, Group CBS, Inc.

Transformer differential protection schemes are ubiquitous to almost any power system. While the basic premise of transformer differential protection is straightforward, numerous features are employed to compensate for challenges presented by the transformer application.

- Current mismatch caused by the transformation ratio
- Current mismatch caused by differing CT ratios
- Delta-wye transformation of currents
- Zero sequence elimination
- LTC induced mismatch, CT saturation, CT remanence, and CT tolerance
- Inrush phenomena and Harmonic content availability
- Over excitation phenomena
- Switch onto fault concerns

These challenges combine to make transformer protection one of the most sophisticated relay systems to test. This paper will explain each of these challenges one at a time, in a technician friendly format.

- **Why Transformers Fail**

Presented By: Drew Walton, Intellirent

In this session we will take a deep dive into transformer failure and bridge the gap between transformer protective relay systems and maintenance testing to form a more holistic approach to the subject. Often there is a disconnect between those responsible for protective relaying and maintenance testing, and by looking at a more complete picture, we can possibly extend the transformer's life expectancy, and avoid catastrophic failure. We will define types of failures, location of failures within the transformer, and examine the difference between electrical, mechanical, and insulation failures. We will show examples and look at various case studies that include interactions between protective relays, and electrical test results. We will also examine diagnostic testing techniques for on-load tap changers and bushings, which make up a large portion of system failures.

- **Primer on Transformer Diagnostic Testing**

Presented By: Brandon Dupuis, OMICRON electronics Corp. USA

Transformers are the largest, most expensive, and highly critical components of most utility substations. To ensure a long, useful service life, it is critical that a power transformer and its ancillary components are tested regularly for incipient fault modes. The seminar focuses on the diagnostic testing that can, and should, be performed during regular maintenance intervals, to ensure that the transformer is in good condition, and can continue its in-service duty with minimal risk. The following electrical transformer diagnostic tests will be discussed,

- Overall Power Factor
- Exciting Current



Learning Resources

On-Demand Training

45-Minute and 4-Hour Courses

- Turns-Ratio (TTR)
- Leakage Reactance (Short-Circuit Impedance)
- Sweep Frequency Response Analysis (SFRA)
- DC Winding Resistance