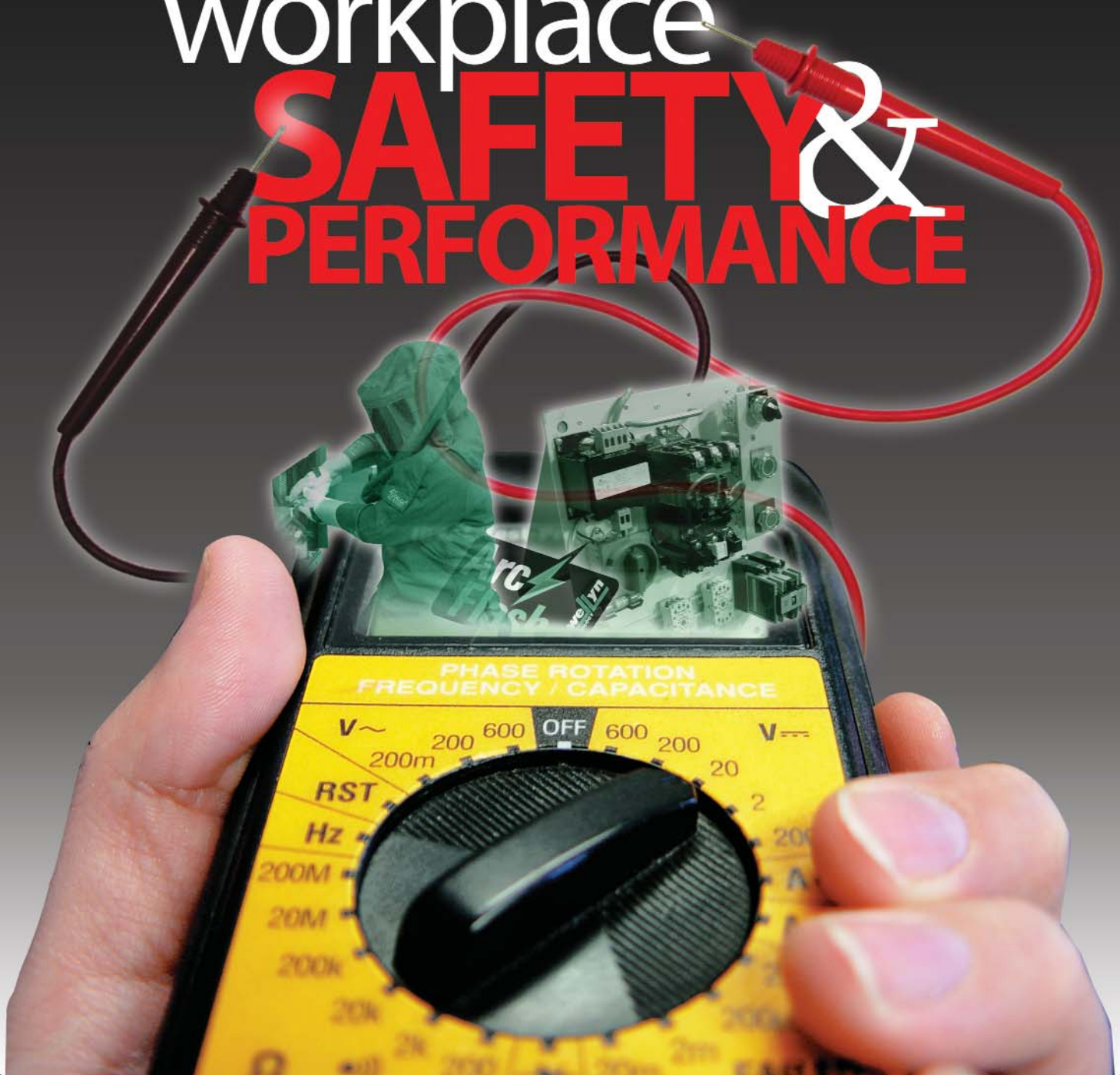


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**2009**  
MAINTENANCE  
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**2009 Maintenance Training Catalog**

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# WHY CHOOSE Lewellyn Technology?

## HOW WE GOT HERE AND WHY WE DO IT

No one should lose their life trying to make a living. This is a foundational belief that has guided Lewellyn Technology since its founding in 1993, and continues to direct our operations today.

Lewellyn was founded by current President and CEO Daryn Lewellyn as a company specializing in electrical maintenance training. Himself a former electrical maintenance worker, Lewellyn saw the need to fill a training vacuum in the profession by starting a company offering practical training to maintenance people, taught by practical instructors. There were four questions used to develop the training programs that still guide us today, and place us at the forefront of training providers in nation:

- **If we have only a short time to talk to maintenance people, and when leaving they must be better at their jobs than when they arrived, what do we tell them?**
- **What do maintenance people spend most of their time doing?**
- **What must they know to do their jobs effectively?**
- **What can we do to make them better troubleshooters, reduce downtime, and make them safer?**

The company eventually grew to an on-site training venture with expanded reach and capabilities, and with the expanded trust of its clients. This evolution was hastened by the publication of the National Fire Protection Association standard 70E, which has become the national consensus standard for protecting employees from electrical hazards including arc flash and shock.

As more companies begin to realize the importance of understanding 70E and its role in protecting employees and OSHA compliance, they turn to Lewellyn for answers. Today, our founder spends much of his time travelling the country hosting free seminars to educate safety personnel on 70E. Lewellyn Technology's Arc Flash Analyses are among the most thorough, comprehensive and results-oriented in the business.

The reason is simple: We value safety over compliance. The main goal of an arc flash analysis is to protect employees. If this is accomplished, compliance will take care of itself. There are ways to cut corners and appear compliant yet still put your employees at risk; Lewellyn is uncompromising in its refusal to do so. That is why we conduct a thorough assessment of the facilities we analyze, use cutting edge technology to identify the hazards, and most importantly, provide our clients with recommendations on how to fix them. We follow-up to ensure you are keeping your people safe and we are transparent in our motivation: We don't sell any of the products we recommend you purchase to mitigate electrical hazards. It's a transparent approach that's becoming increasingly hard to come by in this business.

To date, Lewellyn has improved the staffs of more than 45,000 companies through our arc flash and maintenance programs. The size of our operation rests in the sweet spot between being large enough to handle any client's project, yet small enough to give each project the personal attention it deserves.

True to our roots, we are passionate about providing our clients with a safe, efficient operation in which both the employee and the employer thrive. That is how we improve workplace safety and performance.



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# TRAINING TOPICS & descriptions



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# BASIC INDUSTRIAL electricity

## Basic Industrial Electricity

1-DAY  
TRAINING

### **Training Description:**

Often copied, never duplicated, this is the original Basic Industrial Electricity seminar. In this one-day seminar, attendees will be taken through the basics of Industrial Electricity. This seminar will cover subjects that an Industrial or Institutional Electrician must know to be effective. This is not a seminar on electrical theory; the discussion will be on practical procedures and things you need to know to effectively troubleshoot.

**This powerful one-day seminar** will give you a solid foundation in Industrial Electricity. The seminar starts with the fundamentals of electricity by explaining Voltage, Current, Resistance, and Power, followed by a brief discussion of Ohm's Law. A lengthy discussion of electrical symbols and drawings will follow. This includes analyzing drawings of the electrical systems of real machines from real factories. Transformers will then be discussed. This will include explanations of three-phase and single-phase distribution systems. The seminar will end with an in-depth discussion on motor control and power circuits. You will gain a firm knowledge of motor starters and how they operate in a motor control circuit. This seminar is great for both the beginner and someone with years of experience but no formal training. It is **practical**.

**We will not waste your time with theory. The knowledge you take out of this seminar can be used immediately.**

### **Training Topics:**

#### **FUNDAMENTALS OF ELECTRICITY**

- Current
- Voltage
- Resistance
- Power
- AC and DC
- Ohm's Law

#### **TRANSFORMERS**

- Magnetism
- Transformer Functions  
(Power Plant to Factory)
- Control Transformer Connections

#### **READING AND UNDERSTANDING ELECTRICAL DRAWINGS**

- Symbols
- Relays, Contactors, and Motor Starters
- Ladder Drawings

#### **THREE-PHASE SYSTEMS**

- Three-Phase Motors
- Three-Phase Transformer Connections

#### **CLASS DISCUSSION AND REVIEW**

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# BASIC INDUSTRIAL electricity II

## Basic Industrial Electricity II

1-DAY  
TRAINING

### **Training Description:**

This seminar is designed for those individuals who are familiar with the concepts covered in our Basic Industrial Electricity seminar and want to further their training in this field. Attending Basic Industrial Electricity is not a prerequisite for attending this seminar, but it is recommended.

This seminar will cover three-phase motors in more detail than Basic Industrial Electricity. Motor construction, nameplate data, and principles of operations will be discussed, as well as terminal markings, electrical connections, and enclosures styles. Attend this seminar and learn how to properly size overloads, fuses, and circuit breakers to protect motors. The attendee will learn the common causes of failure for electric motors and the proper steps necessary in troubleshooting. PLCs will also be introduced and discussed in the context of how they apply to maintenance personnel. This will be a good introduction for someone who knows little about them. We will discuss general operation and basic troubleshooting procedures. The material covered in this seminar will be **practical** and is designed to make an **immediate** positive **impact** to your maintenance department.

### **Training Topics:**

#### **THREE-PHASE MOTORS**

- Construction
- Nameplate
- Motor Enclosure
- Motor Connections
- Principles of Operation

#### **MOTOR CIRCUIT COMPONENT SIZING**

- Ground Fault / Short Circuit Protection
  - Fuses
  - Circuit Breakers
- Motor Starters
- Overload Protection

#### **TROUBLESHOOTING**

- Motors
  - Common Causes of Failure
  - Motor Checking
- Control Circuits

#### **PROGRAMMABLE LOGIC CONTROLLERS**

- What They Do
- How They Do It
- Troubleshooting Basics

#### **CLASS DISCUSSION AND REVIEW**

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# HANDS-ONELECTRICAL troubleshooting

## Hands-On Electrical Troubleshooting



### **Training Description:**

This intensive one-day hands-on seminar covers the troubleshooting and repair of control circuits and components. The novice, as well as the experienced electrician, will learn how to safely and efficiently build, troubleshoot, and repair motor control circuits using the hands-on troubleshooting methods covered in this seminar. The attendee will build circuits on realistic training panels that contain a motor starter, relays, terminal strips, push buttons, selector switches, and limit switches. After the circuits are built, the instructor will introduce a realistic fault into the circuit. With the instructor's help, you will be asked to repair the faulty circuit by using your multimeter and the techniques learned earlier in the day.

**This seminar is hands-on** and is very practical in its approach to troubleshooting. The examples you will be shown are applicable to practice in any facility. To insure the quality of this program, this seminar has limited seating. As a result, this seminar fills up quickly, so register early.

**REMEMBER:** Attendees should bring a multimeter, preferably the one they use on the job, with them for this hands-on training.

### **Training Topics:**

#### **MULTIMETER BASICS**

- Ranging
- Reading Multimeters

#### **WHAT IS CONTINUITY**

- Checking Fuses
- Checking Contacts
- Opens & Shorts

#### **RELAYS**

- Ice Cube Relay
- Time Delay Relays
- Machine Tool Relays

#### **THE MOTOR STARTER**

- Pre-wire
- Auxiliary Contacts
- Overload Contacts
- Troubleshooting

#### **TROUBLESHOOTING STEPS**

- Narrowing the Problem
- Half-Splitting Method

#### **THE HANDS-ON PANEL**

- Panel Orientation
- Safety

#### **BUILD AND TROUBLESHOOT CIRCUITS**

#### **CLASS DISCUSSION AND REVIEW**



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# HANDS-ONELECTRICAL troubleshooting II

## Hands-On Electrical Troubleshooting II



### Training Description:

In this seminar you will learn the functions of: off-delay timers, photoelectric sensors, and alternating relays - all while working with motor starters, selector switches, push buttons, control relays, and timers, as well as how to properly troubleshoot three-phase electric motors.

Compared to Hands-On Electrical Troubleshooting, you can expect to wire, troubleshoot, and repair more challenging electrical circuits. You will build electrical circuits that represent common industrial uses such as tank fill control and duplex-pump control, and then repair them after the instructor has inserted a realistic fault. The instructor will work with you one-on-one to find and fix the problem. You will also learn and apply, through hands-on exercises, how to properly test and troubleshoot three-phase motors.

**This seminar is hands-on** and gives each attendee the opportunity to work with real electrical components - while building and troubleshooting from ladder diagrams. If you have already attended Hands-On Electrical Troubleshooting, this seminar will be a nice compliment to the knowledge you have gained. To insure the quality of this program, this seminar has limited seating. As a result, this seminar fills up quickly, so register early.

**REMEMBER:** Attendees should bring a multimeter, preferably the one they use on the job, with them for this hands-on training.

### Training Topics:

#### MULTIMETER BASICS

- Categories and Safety

#### RELAYS

- 8-Pin Tube Base ( Ice-Cube )
- Time Delay On
- Time Delay Off
- Alternating

#### PHOTOCELL OPERATION

#### TROUBLESHOOTING THREE-PHASE MOTORS

- Common Faults
- Common Tools

#### TROUBLESHOOTING TIPS

#### CIRCUITS

- 3-Wire Control
- Permissives
- Multiple Panels
- Hoist Control
- Start Delay
- Staggered Start
- Overheat Protection Using Time-Delay Off
- 3-Wire Control Using Start Relay
- Hydraulic Ram Control
- Automatic Duplex Pump Control
- Two-Speed Motor Control
- Excessive Cycle Prevention
- Short Cycle Prevention
- Circuit Drawing Exercises

#### CLASS DISCUSSION AND REVIEW



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# BASICELECTRICAL ladder drawings

## Basic Electrical Ladder Drawings

1-DAY  
TRAINING

### **Training Description:**

In this one-day seminar you will learn the basics of **reading and understanding electrical ladder drawings**. This seminar is great for both the beginner and someone with years of experience with no formal training. It will cover topics that personnel involved in electrical maintenance must know to effectively use electrical ladder diagrams. This is not a seminar on electrical theory; the discussion will be practical and led by an instructor with many years of industrial maintenance experience.

The seminar starts by explaining various types of electrical ladder diagrams that maintenance personnel use, their applications, and the standards associated with them. This is followed by a detailed discussion on the basic symbols used in electrical ladder diagrams. Included in this discussion are push buttons, selector switches, limit switches, relays, timing relays, motor starters, transformers, and more. Understanding these symbols and what they represent is the foundation for reading electrical ladder diagrams.

You will learn how these symbols are used to make the common motor control circuits used in industry today. Actual electrical ladder diagrams of machinery will be used to reinforce print standards and will be used in realistic troubleshooting examples led by the instructor.

### **Training Topics:**

#### **DRAWING TYPES**

- **Wiring Diagrams**
- **Ladder Diagrams**
- **Symbols**

#### **CONTROL SIDE**

- **Rails**
- **Protection**
- **Rungs**

#### **INPUT DEVICES**

- **Pushbuttons**
- **Selector Switches**

#### **OUTPUT DEVICES**

- **Lights**
- **Horns**
- **Solenoids**
- **Relays**
- **Timers**

#### **POWER SIDE**

- **Motors**
- **Heaters**

#### **CONTROL AND POWER COMBINED REAL WORLD PRINTS**

#### **CLASS DISCUSSION AND REVIEW**

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# ELECTRICAL LADDER drawings I & II

## Electrical Ladder Drawings I & II

2-DAY  
TRAINING

### **Training Description:**

These 2 days of training are designed for both the beginner and the experienced individual involved in electrical maintenance. In today's workplace, the ability to effectively use the electrical ladder drawings for your machines and equipment is essential for working in a safe and efficient manner. The information provided in this seminar will cover electrical ladder drawings used by domestic and international manufacturers for both relay and PLC controlled machines and equipment.

Several multiple page electrical ladder drawings will be examined and discussed to compare the various symbols, cross-reference and numbering systems that are used. You will learn how to use these systems for troubleshooting by participating in instructor led examples.

A portion of this seminar is dedicated to international electrical ladder drawings, their basic symbols, and the standards that are associated to them. Actual international style electrical ladder drawings will be covered to explain the differences and similarities to standard ANSI style electrical ladder drawings.

You will also learn how to read and understand the different electrical ladder drawings used with PLC controlled machines and equipment. We will discuss the various symbols and terminology, and provide the student with information that is needed for troubleshooting these systems.

### **Training Topics:**

#### **DRAWING BASICS**

- Drawing Types
- Laws and Facts
- Symbols
- Control and Power
- Input Devices
- Output Devices

#### **NUMBERING AND GUIDANCE SYSTEMS**

- Device Numbering
- Line, Wire and Multiple Page Numbering
- Guidance Symbols
- Print Examples

#### **IEC DRAWINGS**

- Device Symbols
- Print Example

#### **TROUBLESHOOTING**

- ANSI Ladder Drawings
- IEC Ladder Drawings

#### **PLC DRAWINGS**

- PLC Basics
- Logic Symbols
- Ladder Logic Vs. Ladder Drawings
- Troubleshooting Example

#### **CLASS DISCUSSION AND REVIEW**

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# HANDS-ON DIGITAL multimeter basics

## Hands-On Digital Multimeter Basics



### Training Description:

By attending this seminar, you will learn to read your digital multimeter (DMM). This seminar is hands-on from the moment the instructor greets you in the morning until he sends you home. You will complete exercises where you will measure AC and DC voltage and current, resistance, continuity, capacitance, and more. You will learn to use your meter in troubleshooting procedures and significantly reduce your downtime.

Through these hands-on activities you will gain confidence working with DMMs that you never had before. In today's fast-paced, high-tech industrial environment, it is a must that anyone involved in machine repair be knowledgeable in the operation of DMMs. A slight mistake with a DMM can destroy the meter and possibly cause you a serious injury or damage the equipment you are supposed to be repairing.

This class will teach you how to use a DMM with an emphasis on troubleshooting. You will learn to test electric motors, capacitors, transformers, heating elements, diodes, and much more. You will also learn the proper way to test a fuse in and out of the circuit.

It is necessary for attendees to bring a digital multimeter with them to this hands-on seminar. You will benefit from this course regardless of the type of digital multimeter you use.

**REMEMBER:** Attendees should bring a multimeter, preferably the one they use on the job, with them for this hands-on training.

### Training Topics:

#### INTRODUCTION

- Meter Familiarization Settings
- Manual Vs. Autoranging Specifications

#### METER SAFETY

- Common Hazards
- Inspection
- IEC 61010
- Category
- Solenoid Meters
- Case Studies

#### ELECTRICAL & METER FUNDAMENTALS

- Voltage
- Current
- Resistance
- Power
- Prefixes
- Voltage Lab
- Average Vs. RMS
- Thermocouples
- Current Lab
- Amp Clamps
- Resistance Lab
- Continuity
- Heating Elements
- Ohm's Law
- Power Law
- Ohm's Law Lab
- Capacitance
- Diodes & Lab
- MINMAX & Lab
- Frequency
- Meter Recall

#### CLASS DISCUSSION AND REVIEW



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# WATERWASTEWATER electrical maintenance

## Water/Wastewater Electrical Maintenance

2-DAY  
TRAINING

### **Training Description:**

In this program you will learn the basics of electricity such as, what is current, voltage, resistance, and power. Ohm's Law will be discussed along with magnetism. You will learn about multimeters that can measure voltage, resistance, and current, as well as clamp-on ammeters, and capacitor testers. You will then learn about control components such as transducers, capacitors, float switches, relays, alternators, potential relays, and phase monitors. There will be an in-depth look at reading the electrical control drawings used in the water treatment industry.

You will learn about electric power distribution in your facility; three-phase, single-phase, transformers, and generation. Then you will move into a discussion on Electric Motors of all types and troubleshooting these motors. Motors are very simple to troubleshoot and we will show you how to determine if a motor is bad. We will wrap-up with a unique section we have created just for you called Troubleshooting Lift & Pump Stations. You will learn how to troubleshoot float switches, capacitors, phase monitors, alternators, pumps, and potential relays.

### **Training Benefits:**

- Understanding of basic components.
- Better troubleshooting skills.
- Applicable skills available upon return to the workplace.
- Be able to spot hazards and avoid accidents.

**Prerequisite:** None  
**Standard Class Size:** Up to 20  
**Program Length:** 12 hours  
**CEU s:** 1.2

### **Training Topics:**

#### **FUNDAMENTALS OF ELECTRICITY**

- Current
- Voltage
- Resistance
- Power
- Ohms Law
- AC/DC

#### **MAGNETISM**

- Basic Magnetism
- The Solenoid

#### **WASTEWATER ELECTRICAL PRINTS**

- Symbols
- Relays
- Motor Starter
- Ladder Diagrams
  - Layout
  - Reading
- Timers
- Special Devices

#### **TROUBLESHOOTING**

- Safety Facts
- Voltage Checks
- Current Checks
- Print Troubleshooting

#### **CLASS DISCUSSION AND REVIEW**

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# 2008 NATIONAL electrical code®

2008

**National Electrical Code®**

2-DAY  
TRAINING

## Training Description:

This 2-day seminar is designed to provide a complete overview of the general chapters in the National Electrical Code® including the most pertinent 2008® changes. Participants will learn how to effectively use the 2008 NEC® in applying it to their every day jobs. This seminar is geared specifically for personnel in large buildings, facilities, and industrial settings. Selection of conductors and overcurrent devices will be discussed, as well as wiring methods, wiring materials, grounding & bonding, plus so much more.

## 5 Key Reasons Not to Miss This Training:

You will --

1. Learn the major changes in the 2008 NEC®.
2. Learn how to use and quickly find answers in the NEC®.
3. Discover how the Code® will actually help you to work more efficiently and cost effectively.
4. Learn the requirements to ensure safe electrical installations.
5. Be able to spot electrical hazards and avoid accidents before they happen.

## Training Topics:

**Chapters 1-4 of 2008 NEC® with emphasis on pertinent changes, which may include the following and much more:**

- **Changes in the definition of Bonding Jumper, Grounding Electrode Conductors and Effectively Grounded.**
- **The addition of a Fine Print Note (FPN) to help clarify a Qualified Person.**
- **More restrictive requirement for Flash Protection, which will coordinate with NFPA 70E.**
- **Clarification on Grounded Conductor identification.**
- **New GFCI requirements for outdoor receptacles in public places.**
- **Changes in AFCI requirements.**
- **Restructuring of this article to make it more user friendly.**
- **Clarity on permitted location of Disconnecting Means.**
- **Additional restriction to selection of next higher OC device to protect conductors.**
- **Changes of grounding requirements versus bonding requirements.**
- **Changes in ampacity adjustment factors.**
- **The addition of a new part and new requirements for "Adjustable Speed Drives.**
- **Change in language for location of the motor disconnect.**

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# ARCFLASH

## analysis, consulting, & training

### Arc Flash Analysis, Consulting, & Training

#### **PHASE I:**

#### **Site Assessment and Electrical System Data Gathering**

- Accurate, up-to-date information on the facility electrical system is absolutely essential to the analysis:
  - Transformer Data - KVA, Voltages, Impedance
  - Conductor Sizes and Lengths
  - Fuse and Circuit Breaker Data
  - Electric Utility - Available Capacity (minimum & maximum)
- Develop Accurate One-Line Diagrams

#### **PHASE II:**

- Utilize data from Phase I to evaluate the power system, complete an Arc Flash Analysis using IEEE1584 and NFPA 70E. (We recommend that this be performed by a licensed Professional Engineer.)

#### **Short-Circuit Analysis**

- Required for Coordination Analysis
- Required for Arc Flash Analysis
- Required for Interrupting Rating Analysis

#### **Protective Device Coordination Analysis**

- Determine Total Clearing Time at Given Fault Currents Required for Arc Flash Analysis

#### **Interrupting Rating Analysis**

- Determine if protective devices have adequate interrupting capacity for the available short-circuit current

#### **Arc-Flash Hazard Analysis**

- Calculate Incident Energy (generally at 18 or 24 )
- Calculate Flash Boundary
- Determine Hazard/Risk Category
- Specify PPE Requirements

#### **Recommend Solutions to Problems and Identify Opportunities**

- Coordination Problems
- Inadequate Interrupting Ratings
- Potentially Dangerous Arc Flash Energy
- Opportunities to Reduce Hazard/Risk Category Level

#### **PHASE III:**

- Determine Policies on Electrically Safe Work Conditions
- Develop an Electrically Energized Work Permit
- Establish PPE Requirements Inside Shock Boundaries
- Determine PPE Clothing Policy

#### **Procure Appropriate PPE**

- Flame-Resistant Clothing Based on Hazard/Risk
- Voltage Rated Gloves
- Voltage Rated Tools

#### **Warning Labels**

- Apply Warning Labels to Specified Equipment
- Include Incident Energy, Hazard/Risk Category, Boundaries, and PPE

#### **ELECTRICAL SAFE WORK PRACTICES TRAINING**

- Provide training for all Qualified Employees, Supervisors, and Safety Personnel on Electrical Safe Work Practices Program and Hazard Recognition and Avoidance (Minimum Two Days)
- Provide training for all Affected Employees Operators, Mechanics, and Management (Half-Day)



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# ELECTRICALSAFE work practices



## RECENT CHANGES REQUIRE A QUALIFIED PERSON TO BE TRAINED

Only qualified people are allowed to perform electrical maintenance and testing on live circuits and those qualified people must be trained. The NEC, 70E and OSHA all have this requirement for training.

*Do the definitions to the right define your people?*

### **NFPA National Electrical Code 2008 Article 100 Definitions:**

Qualified person. One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. Updated to include training in the 2002 edition.

### **NFPA 70E 2009 Definitions:**

Qualified person. One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. Updated to include training in the 2004 edition.

### **OSHA 1910.399 Definitions:**

Qualified person. One who has received training in and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved. Updated to include training in 2007.

## Electrical Safe Work Practices



### Training Description:

This two-day seminar is designed for all personnel who work on, around or near any type of electrically energized equipment. Electrical hazards, proper electrical work practices and procedures, and the safe installation of electrical equipment will be discussed.

You will be introduced to the rules and regulations as required by the OSHA Electrical Safety Related Work Practices Standard 1910.331-1910.335. Designed to keep workers safe and up-to-date, this seminar provides life saving information. It is perfect for those who need refresher training, or those who have had little exposure to proper work practices.

**\*Note: This program contains very graphic material.**

### 4 Key Reasons Not to Miss This Training:

You will --

1. Increase your safety awareness.
2. Learn the minimum requirements of the OSHA standards and how they are applied in the work place.
3. Be able to spot hazards, avoid accidents, and prevent costly fines before they happen.
4. Possibly prevent the death or injury of a co-worker or yourself!

## Training Topics:

### REQUIREMENTS FOR ELECTRICAL SAFETY

- OSHA
- Code of Federal Regulations 1910.331-335
- NFPA 70E
- Workplace Safety Programs

### ELECTRICAL HAZARDS

- Shock
- Arc Flash
- Fire
- Electrocution

### QUALIFIED VS. UNQUALIFIED

- Training
- Knowledge
- Approach Boundaries
- Tools and Methods

### WORKING ON OR NEAR LIVE PARTS

- Justification
- Hazard Analysis
- Shock
- Flash

### PERSONAL PROTECTIVE EQUIPMENT

- Fire Resistant Clothing
- Voltage Rated Gloves and Tools
- Selecting PPE, Hazard Analysis Vs. 70E Tables

### REDUCING ELECTRICAL HAZARDS

- Fuses
- Circuit Breakers
- Guarding
- Grounding
- GFCI

### METER SAFETY

- Types
- Category Rating

### ENERGY CONTROL PROGRAM

- Lockout/Tagout
- Training
- Inspection

### CLASS DISCUSSION AND REVIEW



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# THE MANAGEMENT **course** on electrical safety

## The Management Course on Electrical Safety



### **Training Description:**

This course is for managers, supervisors and safety professionals who are involved in overseeing the activities of electrical maintenance staff and others who may be exposed to electrical hazards. This presentation covers the applicable standards and OSHA regulations and management's responsibilities. We will discuss those things that you need to know as a manager to help protect those working for you from electrical hazards. Electrical safety isn't something just the electrical people need to know about. Managers need to be aware of these ever changing electrical safe work practices to better assist in preventing accidents. The goal of this course is to prevent these costly injuries from occurring on the first place.

### **HAZARDS INVOLVED**

- SHOCK
- ARC
- IDENTIFYING HAZARDS

### **PPE REQUIRED**

- IDENTIFYING THE PPE REQUIRED FOR HAZARD LEVEL
- OSHA AND NFPA 70E RELATIONSHIP

### **NFPA 70E 2009 CHANGES**

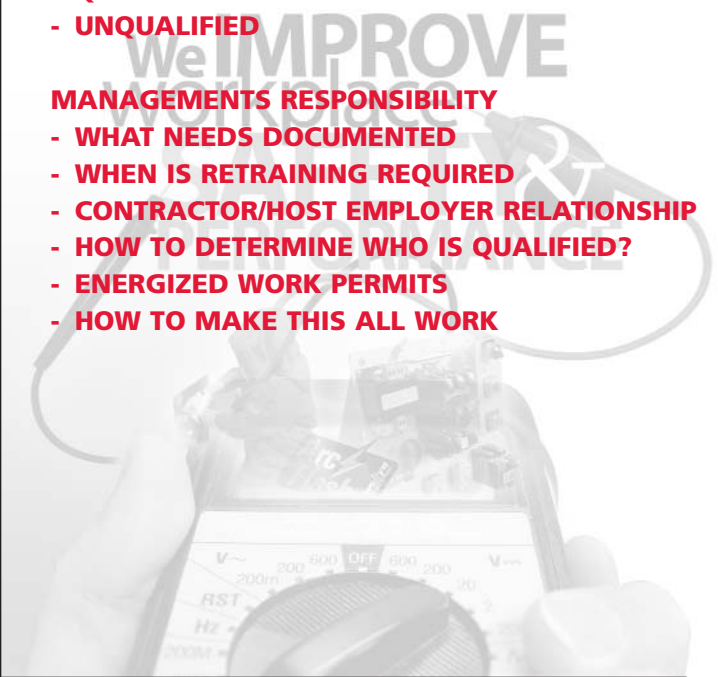
- NEW REQUIREMENTS FOR:
  - DOCUMENTATION
  - PPE
  - LOCKOUT TAGOUT
  - SAFETY AUDITS
  - MORE

### **TRAINING REQUIRED**

- QUALIFIED
- UNQUALIFIED

### **MANAGEMENTS RESPONSIBILITY**

- WHAT NEEDS DOCUMENTED
- WHEN IS RETRAINING REQUIRED
- CONTRACTOR/HOST EMPLOYER RELATIONSHIP
- HOW TO DETERMINE WHO IS QUALIFIED?
- ENERGIZED WORK PERMITS
- HOW TO MAKE THIS ALL WORK



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# **HIGHVOLTAGE** **safety 600 volts & above**

## **High Voltage Safety** **600 Volts & Above**



### **Training Description:**

High Voltage Safety covers the key aspect of the OSHA generation, transmission, and distribution standard 29 CFR 1910.269. This standard applies to organizations that either generate electricity or transmit energy to others. It also applies to organizations that have their own sub-stations or electrical distribution systems.

During this program you will learn to recognize and avoid unsafe work areas. You will also learn correct approach distances. Upon completion, you will have a better understanding of proper voltage rated tools and the use of proper personal protection equipment. By educating workers on issues central to the safe performance of their every day jobs, loss of life or serious injuries can be reduced and eliminated from your workplace. Your safety and the safety of your co-workers depend on it!

### **Training Benefits:**

- Increase your safety awareness.
- Learn how OSHA Standards can work for you.
- Be able to spot hazards and avoid accidents.
- Possibly prevent the death or injury of a co-worker or yourself.

**Prerequisite:** None  
**Standard Class Size:** Up to 20  
**Program Length:** 6 hours  
**CEU s:** 0.6

### **Training Topics:**

#### **ELECTRICAL HAZARDS**

- Electric Shocks, Arcs, and Blasts
- Fault Current and Potential Difference

#### **29 CFR 1910.269: ELECTRIC POWER GENERATION, TRANSMISSION, & DISTRIBUTION**

- Job Briefing Requirements
- Hazardous Energy Control (lockout/tagout)
- Switching Procedures
- Clearance Procedures
- Personal Protective Equipment (PPE)
  - Flame Resistant (FR) Clothing
  - Rubber Protective Equipment
- Live-Line Tools & Testing Requirements
- Working On or Near Exposed Lines
- De-energizing Lines and Equipment
- Personal Protective Grounding
- Sub-station Safety
- Special Conditions
  - Capacitors
  - Current Transformers
  - Potential Transformer Hazards
  - Fuse/Relay Coordination

#### **CLASS DISCUSSION AND REVIEW**



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# **HIGHVOLTAGE** **switching / sub-station maintenance & repair**

## **High Voltage Switching / Sub-Station Maintenance & Repair**

**2-DAY  
TRAINING**

### **Training Description:**

High Voltage has such a large spectrum of levels. It involves many types of equipment and need to know issues. Many companies have a difficult time deciding what degree of training they need. The personnel who need training may range from beginner, to qualified, to expert. Areas of training needed may include safety and the use of proper personal protection equipment, or the ability to recognize specific components in sub-stations and their functions. From switching to sub-station maintenance, Lewellyn Technology and your company are the perfect fit. Let us bring the benefits to you today... improve your High Voltage knowledge, increase safety awareness, and reduce your downtime.

### **Training Benefits:**

- Learn proper switching procedures.
- Understand the functions and components of sub-stations.
- Be able to spot hazards and common problem areas.
- Reduce expensive downtime.

**Prerequisite:** None  
**Standard Class Size:** Up to 20  
**Program Length:** 12 hours  
**CEU s:** 1.2

### **Training Topics:**

#### **INTRODUCTION TO HIGH VOLTAGE SAFETY**

- Electric Shocks
- Arc Blasts

#### **29 CFR 1910.269**

- Hazardous Energy Control (Lockout/Tagout)
- Switching Procedures
- Clearance Procedures
- PPE

#### **TRANSFORMERS**

- Voltage
- CT's and PT's
- Metering

#### **SYMBOLS**

- Switchyard Print Symbols
- Client Will Need to Provide Prints and Charts for Switching

#### **HIGH VOLTAGE SAFETY WITH GROUNDING**

#### **SWITCHING SCENARIOS**

- Perform Instructor Led Switching Scenarios Based on Information and Common Uses Within Switchyards

#### **HIGH VOLTAGE SWITCHING PROCEDURES**

- Examples
- Live Line Tools and Requirements
- Working On or Near Exposed Lines
- Proper De-energizing Procedures With Clearances
- Personal Protective Grounds

#### **SUB-STATION SAFETY**

- Hazards
- Common Problem Areas

#### **DESIGN AND FUNCTION OF SUB-STATIONS**

#### **PROPER MAINTENANCE PROCEDURES**

- Federal
- State
- Company

#### **REASONS FOR FAILURE AND CAUSES OF POSSIBLE INJURY**

#### **MAINTENANCE TIMELINES AND VISUAL INSPECTIONS**

#### **SEPARATELY DERIVED SYSTEM**

- Procedures for Maintaining Multiple Sites from Common Service

#### **CLASS DISCUSSION AND REVIEW**



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# **70E+PLUS** the hands-on solution for your qualified employees

## **70E+Plus**

**3-DAY  
TRAINING**

### **Training Description:**

There is 70E training and then there is 70E+PLUS. The National Electrical Code, NFPA 70E and OSHA now all require that individuals receive safety training before they can be considered Qualified to perform electrical maintenance. Some of the topics included for this training must be:

- *How to select an appropriate volt-meter*
- *How to determine nominal voltage*
- *How to determine the appropriate PPE for the hazard*
- *How to determine Approach Distances based on Voltage*
- *Requirements of OSHA 1910.331 through 1910.335*

In addition it is important they become familiar with the procedures required by NFPA 70E 2009.

70E+PLUS is different because it goes a step further and covers additional material that is needed if your goal is truly avoiding injuries from electrical hazards and not just compliance. 70E+PLUS is hands-on and includes troubleshooting and safety by actually doing it. Hands-On troubleshooting panels will be brought in and the students will actually build circuits and troubleshoot them. Real world examples will be given for students to make decisions concerning PPE and decisions on appropriate troubleshooting techniques. Your plants three phase distribution system will be studied so your qualified employees can better determine system nominal voltages. This course will actually improve troubleshooting skills as well as safety, both will make your plant more efficient. This is truly a unique learning experience.

### **I. OSHA: REGULATIONS AND STANDARDS**

- Code of Federal Regulations
- NFPA 70
- NFPA 70E
- IEEE
- Compliance
- Safety Programs

### **II. QUALIFIED VS. UNQUALIFIED**

- Definitions
- Training Retraining
- Skills Verification
- Contractors

### **III. VOLTAGE**

- Definition
- Exposed and Energized
- Hazard Analysis/Shock
- Determining Nominal Voltages/Labeling
- Approach Boundaries
- Selecting Voltage Rated Protective Equipment
- Selection and Use of Appropriate Voltage Detectors
- Energized Work Permits
- Electrical Rescue

### **IV. CURRENT**

- Definition
- AC/DC
- Magnetic Fields
- Transformers
- Single/Three Phase Systems
- Available Current Levels/Shorts
- Ground Faults
- Circuit Protection and Coordination
- Hazard Analysis/Arc Flash/Labeling
- Selecting Appropriate Personal Protective Equipment
- Protection Boundary and Guarding Requirements

### **V. RESISTANCE**

- Definition
- Conductor Vs. Insulator
- Continuity
- Ohms Law
- Grounding
- Working Clearance



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# UNDERSTANDING nfpa 79

## UNDERSTANDING NFPA 79

1-DAY  
TRAINING

### **Training Description:**

In today's electrical work environment, the proper application of the rules found in the National Electrical Code are very important, however, the NEC rules are not the only rules that may need to be adhered to. We often overlook, but need to consider, that many other standards may apply to our application(s). There are over 22,000 standards published by standards-making organizations.

It is the responsibility of designers, installers, contractors, electricians, engineers, and all users of the National Electrical Code to also become familiar with, and apply the rules found in other applicable standards, which also pertain to the electrical design and installation.

Please be aware, that the application of these "other" Standards is not only optional, but in many cases mandatory. OSHA has a section in both the General Industry Standard (1910.6), as well as in the Construction Standard (1926.31) that uses the terminology "incorporation by reference", which may make these "other" standards just as enforceable as the OSHA standards themselves in certain circumstances.

**Prerequisite:** None  
**Standard Class Size:** Up to 20  
**Program Length:** 6 hours  
**CEU s:** 0.6

### **Training Topics:**

**NEW REQUIREMENTS FOR SHORT CIRCUIT CURRENT RATING TO BE MARKED ON THE EQUIPMENT NAMEPLATE**

**MANDATE FOR ARC-FLASH WARNING SIGNS ON POWER PANELS**

**NEW CHAPTER ON SERVO DRIVES AND MOTORS**

**EXPANDED RULES FOR CONTROL SYSTEMS FOR SAFETY RELATED FUNCTIONS**

**PROTECTION FROM ELECTRIC SHOCK**

**PROTECTION OF EQUIPMENT**

**GROUNDING CONTROL CIRCUITS AND FUNCTIONS**

**WIRING PRACTICES**

**ACCESSORIES AND LIGHTING**

**TESTING AND VERIFICATION**



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# ENERGY ISOLATION

## lockout/tagout procedures

### Energy Isolation Lockout/Tagout Procedures



#### 1. SAFETY IN THE WORKPLACE AND CORPORATE POLICY

- a. Why it is important
  - i. Statistics, examples of how it can make a company more competitive
- b. How to make your workplace safer
  - i. (presentation to be directed towards managers) Enforcement of existing rules with real penalties
  - ii. Lead by example
  - iii. Ensure employees have the tools necessary to do their jobs safely
    1. Ideas that will be helpful on both large and small scales
    2. Include some good low/no budget changes that can still help
  - iv. Ensure employees know what the corporate policy is
    1. how they are individually responsible
    2. what repercussions might be faced
- c. Who has responsibility for what equipment
  - i. Facilities equipment
  - ii. Production equipment
  - iii. Leased or externally owned equipment
- d. Appropriate/common enforcement measures
  - i. How to monitor employee safety without waiting for an accident - most accidents are preventable
  - ii. If employees violate safety policy what should the punishments be
    1. Include specific examples of violations and their punishments

**Prerequisite:** None  
**Standard Class Size:** Up to 14  
**Program Length:** 6 hours  
**CEU s:** 0.6

#### 2. ENERGY SOURCES - LOCKABLE

- i. Electricity
  1. Dangers of electricity (such as how little it can take to be lethal)
  2. Steps to verify that it has been locked out correctly
    - a. Voltmeter
    - b. Attempting a restart
  3. PPE and training required to service if it cannot be locked out (i.e. touching bare live wires)
- ii. Pneumatic
  1. Dangers
    - a. Actuators can move equipment very quickly
    - b. Heating a pressurized vessel will cause pressure to rise, possible explode
    - c. Can blow debris into skin/eyes
  2. Steps to verify that it has been locked out correctly
  3. PPE
- iii. Chemicals and Fuels
  1. Dangers
    - a. Chemical burns, inhalation, etc
    - b. Explosive conditions
    - c. Be sure to read and understand all MSDS information
  2. Steps to verify chemicals have been removed or neutralized safely (LEL etc.)
  3. PPE
- iv. Steam
  1. Dangers
    - a. Burns
    - b. Try to find pictures of people burned by high pressure industrial steam
    - c. The power of even a small leak
  2. Steps to ensure threat has been neutralized
    - a. Double block and bleed
  3. PPE



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# **ENERGY ISOLATION**

## **lockout/tagout procedures**

**(continued)**

### **3. ENERGY SOURCES - NON-LOCKABLE**

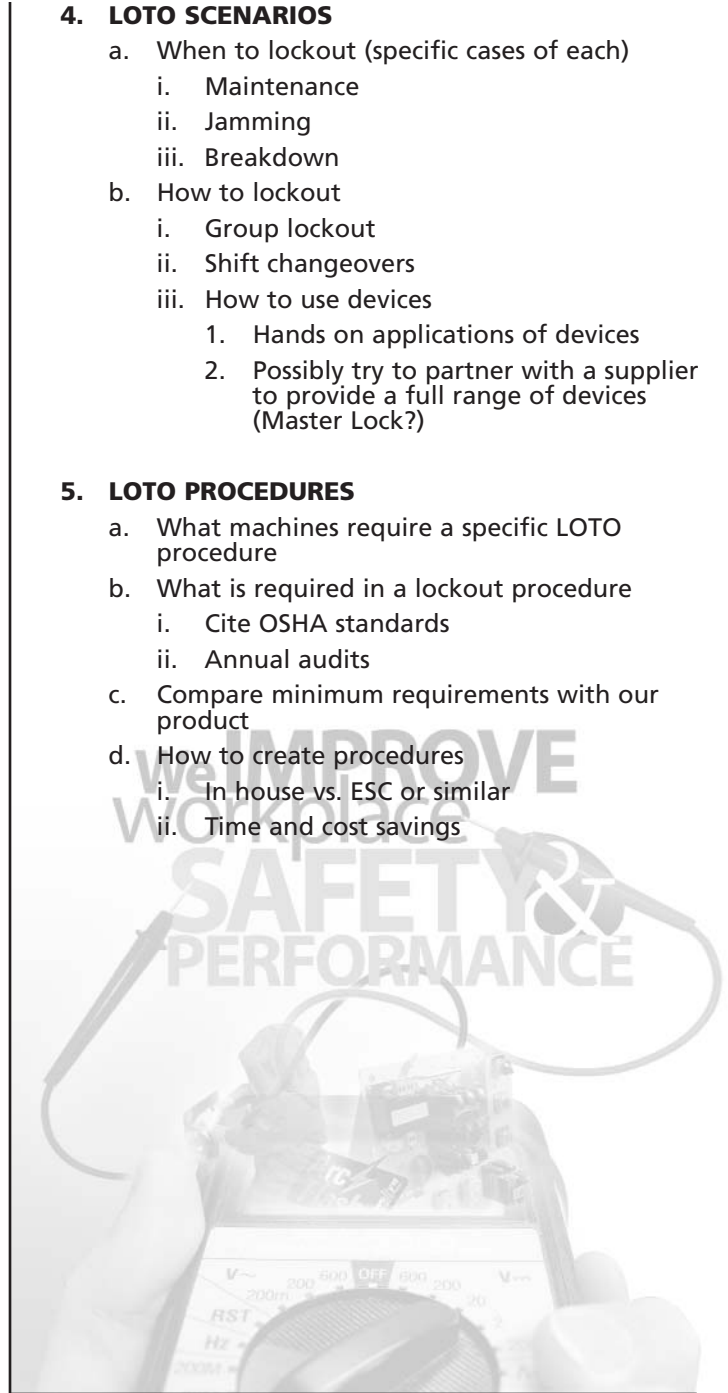
- i. Kinetic
  - 1. Show how much force it would take to stop a common industrial fan or flywheel at low speeds
  - 2. How to verify motion has stopped
    - a. Visual can have an issue if under fluorescent lighting if movement is flickering at 60Hz too
- ii. Gravity
  - 1. Show how much force a typical 4"x4" block can take and compare to the weight and capacity of a typical press
  - 2. How to identify when machine parts need to be secured
  - 3. How to properly secure
- iii. Springs
  - 1. How to identify where spring energy can exist
    - a. Bails of wire or fence
    - b. Springs in overhead doors
    - c. Machine doors or other components
  - 2. How to safely secure or relieve stress from a spring
- iv. Thermal
  - 1. How hot is too hot
  - 2. How you can help dissipate
  - 3. Proper PPE for instances where job prohibits dissipation
    - a. Ducts for molten zinc for die casting is one that I am aware of
    - b. Possibly plastics extrusion too
- v. Hydraulic
  - 1. Compressed fluid can store energy much the same as pneumatic can
  - 2. Get accumulator presentation from JJH

### **4. LOTO SCENARIOS**

- a. When to lockout (specific cases of each)
  - i. Maintenance
  - ii. Jamming
  - iii. Breakdown
- b. How to lockout
  - i. Group lockout
  - ii. Shift changeovers
  - iii. How to use devices
    - 1. Hands on applications of devices
    - 2. Possibly try to partner with a supplier to provide a full range of devices (Master Lock?)

### **5. LOTO PROCEDURES**

- a. What machines require a specific LOTO procedure
- b. What is required in a lockout procedure
  - i. Cite OSHA standards
  - ii. Annual audits
- c. Compare minimum requirements with our product
- d. How to create procedures
  - i. In house vs. ESC or similar
  - ii. Time and cost savings



# BOILER

# fundamentals

## Boiler Fundamentals

2-DAY  
TRAINING

### **Training Description:**

This program has been designed to give the attendee a broad introduction to the most common and important components, principles, and concepts used in boiler systems. You will be trained by a field experienced, Lewellyn Technology instructor. Safe operation practices and boiler efficiency issues will be discussed, as well as the rules and regulations that govern your workplace. You will learn how to perform proper maintenance procedures for your system and how to conduct vessel inspections. The topics presented in this program are designed to help you become a better operator, troubleshooter, and maintenance technician. Upon completion of this course, you will have a solid knowledge of basic boiler systems, the components and accessories used in these systems, how and why boiler systems work, and an understanding of present dangers if not operating your system safely.

### **Training Benefits:**

- Proper installation procedures of components.
- Reduced costs to outside contractors.
- Increased knowledge of industry terminology.
- Understanding diagrams and schematics.
- Reduce energy costs.

**Prerequisite:** None  
**Standard Class Size:** Up to 20  
**Program Length:** 12 hours  
**CEU s:** 1.2

### **Training Topics:**

#### **COMBUSTION**

- Fuel
- Draft
- Burner Operation

#### **FUNDAMENTALS OF HIGH & LOW PRESSURE BOILERS**

- Boiler Theory & Types
- Boiler Classification
- Pressure & Temperature

#### **BASIC BOILER ROOM SYSTEMS**

- Fuel System
- Draft System
- Feedwater System
- Steam System

#### **OPERATING & SAFETY DEVICES**

- Safety Valves
- Low Water Cutout Controls
- Operating Controls
- Limit Controls

#### **BOILER OPERATIONS**

- Operating Standards
- Safe Operation
- Efficient Operation

#### **BOILER & PRESSURE VESSEL ACCIDENTS**

- Boiler Room Safety
- Accidents, Cause & Effect
- Statistical Analysis of Accidents

#### **CASE STUDY**

- Boiler Explosion

#### **NATIONAL, STATE, LOCAL JURISDICTIONAL RULES & REQUIREMENTS**

- American Society of Mechanical Engineers
- National Board Inspection Code
- National Fire Protection Association Code
- Controls & Safety Devices for Automatically Fired Boilers (CSD-1)

#### **PREVENTIVE MAINTENANCE**

- Routine Boiler Maintenance
- Safety Valve & Low Water Cutout Control Tests
- Efficiency Tests
- Waterside & Fireside Maintenance

#### **BOILER & PRESSURE VESSEL INSPECTION**

- Preparing Your Boiler for Inspection
- Internal Inspection
- External Inspection
- Operational Inspection
- Hydrostatic Pressure Test

#### **STATIONARY ENGINEERING**

- Boiler Operator Licensing Requirements
- Question & Answer Session

#### **CLASS DISCUSSION AND REVIEW**



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# WATERTREATMENT for boilers & cooling systems

## Water Treatment For Boilers & Cooling Systems

2-DAY  
TRAINING

### **Training Description:**

Efficiency in practical operations ensures that your department meets budget requirements and helps prolong the life of your plant water treatment equipment. You have paid for water treatment, service, and maintenance. Through cost-effective water treatment (effective knowledge management) you will take a proactive approach in maintaining the proper equipment with the right size personnel. This program will give you the tools to adjust and adapt to changing conditions. During the program, you will learn a practical, no-nonsense, hands-on approach to help reduce operating costs for your facility and key personnel. It delivers educational information to plant personnel for maximum retention and application resulting in the greatest return on your investment.

**Note:** Each topic will begin with a State of Industry review and end with a question session.

### **Training Benefits:**

- Proper installation procedures of components.
- Reduced costs to outside contractors.
- Increased knowledge of industry terminology.
- Understanding diagrams and schematics.
- Reduce energy costs.

**Prerequisite:** None  
**Standard Class Size:** Up to 20  
**Program Length:** 12 hours  
**CEU s:** 1.2

### **Training Topics:**

#### **BOILERS**

- Boiler Water Characteristics
- External Treatment
  - Softeners, Dealkalizers, Deaerators
- Internal Treatments
  - Inhibitors, Polymers
- Oxygen Scavengers, Return Line Treatments
- Energy Saving Equipment
- Boiler Control Equipment
- Monitoring & Troubleshooting Equipment
- Calculations
  - Chemical, Water, Condensate
- Return on Investment
- Boiler Bid Specification

#### **COOLING**

- Cooling Water Characteristics
- Corrosion, Scale, Biological Fouling
- Treatments
  - Inhibitors, Deposit Agents
- Treatments
  - Oxidizing & Non-oxidizing
- Treatments
  - Closed Loops, Softwater, Acid
- Cooling Control Equipment
- Monitoring & Troubleshooting Equipment
- Calculations
  - Chemical vs. Water
- Return on Investment
- Cooling Bid Specification

#### **CLASS DISCUSSION AND REVIEW**

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# BOILEROPERATION training

## Boiler Operation Training

3-DAY  
TRAINING

### **Training Description:**

The training will be focused on the facility equipment in addition to the class room equipment. The course will have pre and post exams, the post exam will be graded either by the instructor or an independent agency. The exam results will show a total percentage grade and indicate where improvements are needed. Certificates will be provided to students upon successful completion of the class.

**Prerequisite:** None  
**Standard Class Size:** Up to 15  
**Program Length:** 18 hours  
**CEU s:** 1.8

### **Training Topics:**

- I. INTRODUCTIONS**
    - ATTENDEES INTRODUCTIONS
    - PURPOSE OF COURSE
    - OPERATOR RESPONSIBILITIES
  - II. BOILER BASICS**
    - DEFINITIONS AND TYPES
    - THERMODYNAMICS
    - WATER TREATMENT
  - III. FLAME SAFEGUARD SYSTEM**
    - SEQUENCE OF OPERATION
    - PURGE REQUIREMENTS
    - SAFETY INTERLOCKS
    - IGNITION AND PROOF OF FLAME
    - FLAME DETECTORS
    - SHUTDOWN PROCEDURES
  - IV. OPERATING AND SAFETY CONTROLS**
    - PURGE INTERLOCKS
    - LOW FIRE INTERLOCKS
    - AIRFLOW INTERLOCKS
    - TEMPERATURE INTERLOCKS
    - PRE-IGNITION INTERLOCKS
  - IV. CODES AND STANDARDS**
    - ASME NATIONAL BOARD
    - CODE REQUIREMENTS
    - CSD-1 AND NFPA 85
  - V. COMBUSTION EQUIPMENT**
    - TYPES OF BURNERS
    - COAL FIRED EQUIPMENT
    - COMBUSTION AIR CLASSIFICATION
    - FUEL DELIVERY SYSTEMS
      - GAS TRAIN REQUIREMENTS
      - VENTING REQUIREMENTS
  - VI. COMBUSTION THEORY AND TUNING**
    - COMPONENTS REQUIRED
    - COMBUSTION REQUIREMENTS
    - PROPER FUEL/AIR MIXTURE
    - TUNING THE BURNER/BOILER
  - VII. INTERLOCK AND LEAK TESTING**
    - PRE-START CHECK LIST
    - ENGINEERING ASSESSMENT
    - VALVE LEAK TESTING
    - INTERLOCK TESTING
- CLASS DISCUSSION AND REVIEW**



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# BOILERSAFETY, nfpa85, and csd1 compliance training

## Boiler Safety, NFPA 85, and CSD1 Compliance Training

2-DAY  
TRAINING

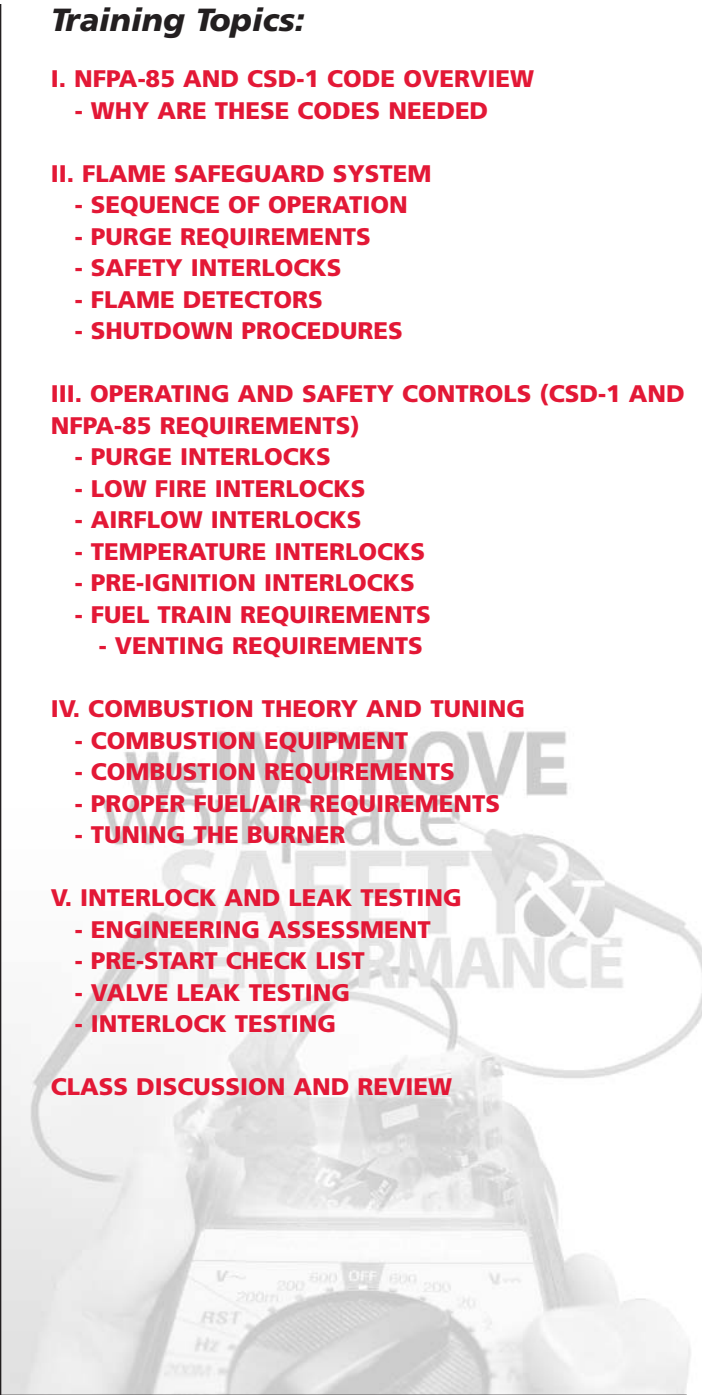
### **Training Purpose:**

To familiarize the student with the safe operation of the boiler and combustion system and to provide the student with knowledge of CSD-1 and NFPA-85, plus the requirements and procedures for compliance.

**Prerequisite:** None  
**Standard Class Size:** Up to 14  
**Program Length:** 16 hours  
**CEU s:** 1.6

### **Training Topics:**

- I. NFPA-85 AND CSD-1 CODE OVERVIEW**
  - WHY ARE THESE CODES NEEDED
  
- II. FLAME SAFEGUARD SYSTEM**
  - SEQUENCE OF OPERATION
  - PURGE REQUIREMENTS
  - SAFETY INTERLOCKS
  - FLAME DETECTORS
  - SHUTDOWN PROCEDURES
  
- III. OPERATING AND SAFETY CONTROLS (CSD-1 AND NFPA-85 REQUIREMENTS)**
  - PURGE INTERLOCKS
  - LOW FIRE INTERLOCKS
  - AIRFLOW INTERLOCKS
  - TEMPERATURE INTERLOCKS
  - PRE-IGNITION INTERLOCKS
  - FUEL TRAIN REQUIREMENTS
  - VENTING REQUIREMENTS
  
- IV. COMBUSTION THEORY AND TUNING**
  - COMBUSTION EQUIPMENT
  - COMBUSTION REQUIREMENTS
  - PROPER FUEL/AIR REQUIREMENTS
  - TUNING THE BURNER
  
- V. INTERLOCK AND LEAK TESTING**
  - ENGINEERING ASSESSMENT
  - PRE-START CHECK LIST
  - VALVE LEAK TESTING
  - INTERLOCK TESTING
  
- CLASS DISCUSSION AND REVIEW**



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# STEAMSYSTEM seminar

## Steam System Seminar

**2-DAY  
TRAINING**

**Prerequisite:** None  
**Standard Class Size:** Up to 14  
**Program Length:** 16 hours  
**CEU s:** 1.6

## **Training Topics:**

### **I. INTRODUCTIONS**

- A. ATTENDEES AND INSTRUCTOR INTRODUCTIONS**
- B. PURPOSE OF TRAINING**
- C. GENERAL DISCUSSION OF THE PLANT SYSTEMS  
WHAT ARE THEY AND PURPOSE**

### **II. THERMODYNAMICS**

- A. WHAT IS STEAM?**
- B. DEFINITION OF A BTU**
- C. ENTHALPY STEAM TABLE**
- D. HEAT TRANSFER**
- E. SUPERHEAT**

### **III. STEAM PIPING CODE**

- A. ASME, B31.1**
- B. LOCAL - STATE CODES**
- C. PP STAMP**
- D. MATERIALS OF CONSTRUCTION**
- E. CERTIFIED WELDERS**
- F. STEAM PIPING EXPLOSIONS**
- G. VALVE REQUIREMENTS**

### **IV. SYSTEM DESIGN**

- A. PIPE SIZING VELOCITIES AND PRESSURE DROP**
- B. EXPANSION AND CONTRACTION**
- C. PIPE HANGERS AND ANCHORING**
- D. DRIP LEGS AND STEAM TRAP LOCATIONS**
- E. STEAM TRAP PIPING**
- F. USE OF PRESSURE REDUCING VALVES**
- G. STEAM LINE TREATMENT**

### **V. STEAM TRAPS**

- A. TYPES AND DESIGN...**
- B. APPLICATIONS OF**
- C. OPERATION OF**
- D. MAINTENANCE**
- E. TESTING**

### **CLASS DISCUSSION AND REVIEW**



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# **HANDS-ON PLC** **troubleshooting & maintenance**

## **Hands-On PLC Troubleshooting & Maintenance Using MicroLogix 1000**

**2-DAY  
TRAINING**

### **Training Description:**

This hands-on program is a practical look at programmable controllers. It is intended to familiarize you with Programmable Logic Controller concepts. It will be kept very practical and most of the time you spend in class will be with your hands actually on a PLC; learning to program, edit, diagnose, and troubleshoot. The emphasis will be on teaching you concepts that will make you a better troubleshooter. Learning to repair equipment controlled by PLCs can be frustrating without a working knowledge of PLCs. In this program you will learn the concepts to help you repair equipment faster and make changes to existing programs in your plant. This powerful program will teach you what the pros know about PLCs.

### **Training Benefits:**

- Capability of writing programs on your own
- Develop advanced troubleshooting skills
- Better understanding of programming
- Applicable skills available upon return to the workplace

**Prerequisite:** None  
**Standard Class Size:** Up to 14  
**Program Length:** 12 hours  
**CEU s:** 1.2

### **Training Topics:**

You will complete numerous instructor-led exercises which will get more challenging with each new assignment. Some will be modifying a program from an earlier exercise; others will be developing entirely new programs that the attendees will write as a team or individually. At the completion of training, you will be creating programs on your own, which will leave you with a feeling of accomplishment. This information is applicable to any brand of PLC.

#### **PLC COMPONENTS**

- I/O Section
- CPU
- Power Supply
  - Addressing
- What is Addressing
- Types of Addressing
  - Ladder Logic vs Statement Lists
- Instruction Set
- Conditional Instructions
- Output Type Instructions
- Timers
  - Troubleshooting The PLC
- General Troubleshooting Rules
- Proper Meter Usage
- Understanding the PLC Lights
- Output Section Troubleshooting
- Internal vs External Problems
  - 18 Hands-On Labs With Troubleshooting

#### **CLASS DISCUSSION AND REVIEW**



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# **BASIC HANDS-ON PLC fundamentals & troubleshooting I**

## **Basic Hands-On PLC Fundamentals & Troubleshooting I**

**1-DAY  
TRAINING**

### **Training Description:**

Understanding and repairing equipment controlled by PLCs can be very frustrating without a working knowledge of PLCs. By taking the student through numerous in-class, hands-on activities, this intensive hands-on seminar has been designed to take the mystery out of Programmable Logic Controllers.

This seminar will take you step-by-step through testing the power supply, input and output devices on an actual PLC. You will use our advanced PLC trainers to learn the process of connecting devices to the PLC and writing programs to make them work by actually doing it. With an emphasis on making you a better PLC troubleshooter, this Hands-On class will give you the knowledge to help you succeed in today's automated world.

### **Training Topics:**

#### **PROGRAMMABLE LOGIC CONTROLLERS**

- What They Do
- How They Do It

#### **MAJOR COMPONENTS OF THE PLC**

- Input/Output Modules
- Central Processing Unit
- Power Supply
- Programming Device

#### **PLC CONFIGURATIONS**

- Integral
- Modular

#### **PLC BASICS**

- Connection Points
- Component Operation
- Troubleshooting "Check the Lights"

#### **PLC PROGRAMMING PRINCIPLES**

- Numbering Systems
- Addressing
- Instruction Sets
- Program Execution

#### **PLC DOCUMENTATION**

- Ladder Drawings
- Ladder Logic
- Cross Reference

#### **EMPHASIS ON ELECTRICAL SAFE WORK PRACTICES**

#### **CLASS DISCUSSION AND REVIEW**



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# **BASIC HANDS-ON PLC fundamentals & troubleshooting II**

## **Basic Hands-On PLC Fundamentals & Troubleshooting II**

**1-DAY  
TRAINING**

### **Training Description:**

Building on the skills obtained in Basic Hands-On PLC Fundamentals & Troubleshooting I, you will learn to connect and troubleshoot NPN, PNP, sourcing and sinking input devices, along with understanding the important process of troubleshooting these devices. You will learn how counters, timers, and other programming functions work, and how to troubleshoot the input and output circuits associated with PLCs. By the end of this second day you will have wired and learned to troubleshoot a real PLC with operating sensors, switches, relays, and contactors found in most real world machines.

Attending Basic Hands-On PLC Fundamentals & Troubleshooting I is not a prerequisite for this seminar, but it is highly recommended.

### **Training Topics:**

#### **PROGRAMMABLE LOGIC CONTROLLER I/O HARDWARE**

- **Operation and Troubleshooting AC I/O**
- **Operation and Troubleshooting DC I/O**
  - **Sinking**
  - **Sourcing**
- **Working with Proximity Switches**
- **Troubleshooting Using Multimeters**

#### **PLC ADDRESSING**

- **Purpose**
- **Manufacturers Examples**

#### **PLC PROGRAMMING**

- **Instructions**
  - **Conditional**
  - **Output**
  - **Internal Bits**
  - **Timers**
  - **Counters**
- **Scan Cycle**
- **Program Execution**

#### **TROUBLESHOOTING EXAMPLES**

- **With Documentation**
- **Working with an Unknown System**

#### **CLASS DISCUSSION AND REVIEW**



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# **HANDS-ON PLC** **programming & maintenance using** **RSLogix™ software**

## **Hands-On PLC Programming & Maintenance Using RSLogix™ Software**



### **Training Description:**

The leader in PLC applications in the United States is Allen Bradley. We utilize SLC 5/02 processors and RSLogix™ software in our hands-on programming section. The student is first introduced to the common screens of both RSLogix™ and RSLinx™. Once the student is familiar with the common screens the class advances to entering simple programs, monitoring these simple programs, and modifying/editing the existing programs. As the program progresses the labs become more complex. The students are encouraged to work at their own pace while being assisted by the instructor. The students are shown how to recover from a power failure, upload and download programs, and set up reporting for troubleshooting when the need arises.

### **Training Benefits:**

- Increase knowledge of major functional components of the Allen-Bradley SLC 500.
- Develop advanced troubleshooting skills.
- Understanding RSLogix™ software.

**Prerequisite:** None  
**Standard Class Size:** Up to 14  
**Program Length:** 18 hours  
**CEU s:** 1.8

### **Training Topics:**

#### **WHAT IS A PLC**

- Configurations
- Integral
- Modular

#### **COMPONENTS OF A PLC**

- I/O Modules
- CPU
- Power Supply
- Programming Devices

#### **PROGRAMMING**

- Instruction Set
- Examine On & Off
- Addressing
- Program Execution
- Scan Cycle

#### **UNDERSTAND PLC TROUBLESHOOTING METHODOLOGY**

- "Check the lights!"

#### **PROGRAMMING DEVICE INTRODUCTION**

- Using Computer to Interface
- Programming Menus
- Menu Organization & Layout

#### **INSTRUCTIONS AND EXERCISES**

- Internal Bits
- File Exercises
- Latch & Unlatch
- Timers & Counters

#### **ADDITIONAL REFERENCES**

- More Instructions
- PLC Wiring
- Tracking Bits for Troubleshooting

#### **CLASS DISCUSSION AND REVIEW**



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# HANDS-ON VARIABLE frequency drives

## **Hands-On Variable Frequency Drives**

**2-DAY  
TRAINING**

### **Training Description:**

In this two-day hands-on seminar you will learn about the operation, setup and maintenance of AC Variable Frequency Drives. It is designed to familiarize maintenance personnel with the concepts and principles necessary to repair and troubleshoot VFD systems. The following will be covered:

#### **AC Drive Fundamentals**

Regardless of the manufacturer, all AC Variable Frequency Drives Systems have two major components: AC induction motor and variable speed controller. Understanding these two components and how they work together will increase your ability to troubleshoot in a variety of applications.

#### **Types and Applications**

Variable Frequency Drives are used in a variety of applications including pumps, blowers, fans, compressors, and other machinery. This seminar will teach you the benefits of using this variable speed technology in these applications and which style of controller can and should be used.

#### **Setup and Operation**

You will learn the basic setup of parameters, control wiring, and safety precautions necessary for installing an AC Variable Frequency Drive. Various drive features will be discussed including operating modes, braking types, automatic restart, and many more.

#### **Maintenance Troubleshooting**

You will learn hands-on the basic requirements necessary for an AC Variable Frequency Drive to function properly, and how to recognize problems when it doesn't. We will discuss common faults, their causes, and how they can be repaired.

Using your multimeter, you will be instructed how to seek out failures in the VFD control system. This hands-on approach will help you learn to be an efficient troubleshooter on VFD systems.

**REMEMBER:** Attendees should bring a multimeter, preferably the one they use on the job, with them for this hands-on training.

### **Training Topics:**

#### **GENERAL AC DRIVES VS. DC DRIVES**

- Background information
- Why AC drives

#### **AC DRIVES**

- AC motors
  - Applications
  - Induction motors
  - Inverter duty motors
  - Selection method for motors

#### **Starting Methods**

- Manual starting
- Automatic starting
- Other starting methods

#### **Drive Types and Applications**

- Comparison of each type

#### **Setup and Operation**

- Installation precautions
- Basic setup parameters
- Operating modes

#### **Maintenance Troubleshooting**

- Safety precautions
- Common fault codes
- Common causes of failure
- Motor Vs. Drive troubleshooting

#### **Meter Uses and Safety**

#### **Hands-On Lab Exercises**

- Two wire controls
- Three wire controls
- Potentiometers using 0-10VDC
- Preset Speed controls

#### **CLASS DISCUSSION AND REVIEW**



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# TROUBLESHOOTING automated equipment

## **Troubleshooting Automated Equipment**



### **Training Description:**

In this program, you will learn how to properly troubleshoot control devices of various types. It will take away many of the mysteries commonly associated with automated equipment control devices; such as temperature switches, photo switches, transducers, and tachometers. You will learn proper troubleshooting procedures, and applications. Common failures will be discussed, pointing out common problems that maintenance personnel deal with on a daily basis in many industries. These troubleshooting exercises will help you in finding and fixing the problem in a timely fashion.

### **Training Benefits:**

- Better troubleshooting methods.
- Understanding functions of basic components.
- Successful set-up of systems.
- Know the different types of systems.

**Prerequisite:** None  
**Standard Class Size:** Up to 20  
**Program Length:** 6 hours  
**CEU s:** 0.6

### **Training Topics:**

#### **SENSORS**

- Switching - Digital Control
- Feedback - Variable Control
- Primary Purposes

#### **DIGITAL CONTROL DEVICES**

- Temperature Switches
- Pressure Switches
- Photoelectric Switches
- Proximity Switches
- Labs

#### **VARIABLE CONTROL DEVICES**

- Pressure Transducer
- Thermocouples
- Tachometer
- Labs

#### **APPLICATIONS**

- PLC s
- Controllers
- Motor Drives
- Proper Procedures
- Common Failures
- Replaceable Components

#### **TROUBLESHOOTING**

#### **CLASS DISCUSSION AND REVIEW**



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# DIRECT DIGITAL CONTROLS in BAS & HVAC systems

## Direct Digital Controls in BAS & HVAC Systems

2-DAY  
TRAINING

### **Training Description:**

You will learn every subject described in the seminar topics, including concepts and principles necessary to understand how to maintain, operate, install, and program any DDC vendors system.

Everything is taught on a how, why, pros and cons basis. There will be some hands-on training, as well as typical real-life examples of mechanical HVAC applications, power management, lighting, and more.

During this information-packed seminar, the instructor will lead you through two exciting days of learning all about DDC systems.

### **Training Benefits:**

- Fix annoying recurring problems by knowing how your system works.
- Troubleshoot your system faster.
- Start programming and installing your own remodels, improvements, or modifications.
- Reduce total building cost.
- Reduce third-party maintenance contract costs.
- Simplify facility management.
- Better use of maintenance staff time.

**REMEMBER:** Attendees should bring a multimeter, preferably the one they use on the job, with them for this hands-on training.

### **Training Topics:**

- What is DDC?
- Typical System Architecture
- Inputs / Devices / Points
- Outputs / Devices / Points
- Microprocessor Controllers
- Types, Description, Operation
- Communication, Addressing
- PID Process Control, Functional Issues
- Energy Management Features
- Programming / All Types
- Application and Device Operations
- How to Calibrate and Adjust Any Device
- Networks Architectures
- Appliances / Types, Descriptions
- Proper Installation, Guidelines
- Protocols / Types, Descriptions

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# BASIC AIR CONDITIONING & refrigeration I

## Basic Air Conditioning & Refrigeration I

1-DAY  
TRAINING

### **Training Description:**

This information packed one-day seminar has been designed to give the attendee an understanding of the most important components, principles, and concepts used in air conditioning and refrigeration systems. Upon completion of this seminar you should have a solid knowledge of servicing air conditioning and refrigeration systems, the components and accessories used in these systems, and an understanding of the electrical considerations necessary for making these systems work.

(EPA certification is optional and requires the attendee to pass a test administered by the instructor at the end of **Basic Air Conditioning & Refrigeration II**. While every attempt is made to provide our attendees with a high quality education, Lewellyn does not guarantee that all attendees will pass this test. It is highly recommended that attendees study **on their own** in addition to taking this training.)

### **Training Topics:**

#### **BASIC AIR CYCLE**

- Return Duct and Make-Up Air Intake
- Air Filtration
- Blower Assembly
- Evaporator and Pan Drain
- Supply Duct and Resistors

#### **ESSENTIAL COMPONENTS**

- Compressor
- Condenser
- Evaporator
- Metering Device

#### **SYSTEM ACCESSORIES**

- Receiver
- Accumulator
- Sight Glass
- Oil Separator
- Oil Return
- Tubing

#### **REFRIGERANT CYCLE**

- Temperature
- Pressure
- Liquid
- Gas

#### **RECOVERY/RECLAIM/CHARGING**

- Pressure/Gauges
- Evacuation
- Leak Detection
- Refrigerant
- Charging
  - Vapor
  - Liquid

#### **TROUBLESHOOTING**

- Pressure
- Temperature

#### **CLASS DISCUSSION AND REVIEW**

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# BASIC AIR CONDITIONING & refrigeration II

## Basic Air Conditioning & Refrigeration II

1-DAY  
TRAINING

### **Training Description:**

In this second one-day seminar, you will gain insights to proper troubleshooting techniques for both mechanical and electrical related problems in your system. We will give you the need to know on how the EPA and Clean Air Act affect your job. You will learn how to effectively find problems, troubleshoot, and repair the controls used in most AC/Refrigeration systems. This seminar builds on the fundamentals already presented in Basic Air Conditioning & Refrigeration I.

(EPA certification is optional and requires the attendee to pass a test administered by the instructor at the end of **Basic Air Conditioning & Refrigeration II**. While every attempt is made to provide our attendees with a high quality education, Lewellyn does not guarantee that all attendees will pass this test. It is highly recommended that attendees study **on their own** in addition to taking this training.)

### **Training Topics:**

#### **SAFETY**

- Pressures
- Temperatures
- Electrical Hazard

#### **ELECTRICAL TROUBLESHOOTING**

- **Multimeter Basics**
- **Fundamentals of Electricity**
- **Schematic Reading**
  - Symbols
  - Circuit Logic
  - Wiring Diagrams
- **Testing Compressor Windings**
- **Components**
  - Current Relays
  - Fan Sequencing Relays
  - Potential Relays
  - Pressure Switches
  - Fusing
  - Capacitors
  - Thermostats
  - Hard Start Kit

#### **MECHANICAL TROUBLESHOOTING**

- Belts and Pulleys
  - Alignment
  - Tension
  - Replacement

#### **CLASS DISCUSSION AND REVIEW**

**EPA  
Certification  
Testing  
Available**

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# AIRCONDITIONING and chilled water systems

## Air Conditioning and Chilled Water Systems

3-DAY  
TRAINING

**Prerequisite:** None  
**Standard Class Size:** Up to 14  
**Program Length:** 18 hours  
**CEU s:** 1.8

### **Training Topics:**

#### **I. INTRODUCTION AND OVERVIEW**

- ATTENDEES INTRODUCTION
- OBJECTIVES AND CONTENTS OF THE COURSE
- USE OF CHILLED WATER SYSTEMS

#### **II. REFRIGERATION THEORY**

- THERMODYNAMICS ... HEAT TRANSFER THEORY
- CHILLED WATER REFRIGERATION CYCLE
- COMPRESSION CYCLE THEORY
- ABSORPTION COOLING THEORY

#### **III. REFRIGERANTS**

- EPA 608 CERTIFICATION REQUIREMENTS
- TYPES OF REFRIGERANTS
- ABSORPTION REFRIGERANTS

#### **IV. SYSTEM COMPONENTS**

- COMPRESSORS
- EVAPORATORS
- METERING (EXPANSION) DEVICES
- HEAT REJECTION SYSTEMS

#### **V. CONTROLS AND CONTROL SYSTEMS**

#### **VI. PUMPS**

- PUMP THEORY
- CENTRIFUGAL PUMP OPERATION
- PUMP MAINTENANCE

#### **VII. PIPING SYSTEMS**

- OPEN LOOP
- CLOSED LOOP
- MATERIALS OF CONSTRUCTION

#### **VIII. CONDITIONED SPACE SYSTEMS**

- FAN COIL UNITS
- AIR FILTERS

#### **CLASS DISCUSSION AND REVIEW**

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# HEATING service & troubleshooting

## Heating Service & Troubleshooting

2-DAY  
TRAINING

### Training Description:

You will learn proper start up and service procedures, troubleshooting by use of sequence of operation and wiring diagrams, and analyzing mechanical and electrical problems encountered when servicing gas heating systems. This class will assist with your understanding the proper approach to solve specific problems in the minimal amount of time required. You must recognize safety information and follow all safety instructions and observe safety practices. Failure to follow safety warnings could result in equipment dangers, serious personal injury or death.

### Training Benefits:

- Increased safety awareness.
- Reduce costly downtime.
- Learn proper service procedures.
- Better understanding of the 80+ and 90+ systems.
- Reduce outside contractor costs.

**Prerequisite:** None  
**Standard Class Size:** Up to 20  
**Program Length:** 12 hours  
**CEU s:** 1.2

### Training Topics:

#### SERVICE PROCEDURES

#### FURNACE OPERATION

- 80+ sequence of operation-wiring diagram
- 90+ sequence of operation-wiring diagram

#### INSTALLATION

- Duct Sizing/CFM
- Mounting
- Plumbing
- Electrical
- Accessories
- Drain

#### TROUBLESHOOTING

- Venting
- Installation
- Air Distribution

#### GAS VENTING

- Vents and Flues
- Vent Sizing
- Installation
- PVC
- B-Vent
- Troubleshooting

#### ELECTRICAL SYSTEMS

- Components
- Schematic and Pictorial
- Sequence of Operation

#### COMBUSTION AIR

- Confined Spaces
- Diagnosing Flame Problems
- Floating Flames
- Flame Rollout

#### IGNITION SYSTEMS

- Spark
- Hot Surface

#### CLASS DISCUSSION AND REVIEW

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# HANDS-ON MECHANICAL maintenance troubleshooting & repair I

## Hands-On Mechanical Maintenance Troubleshooting & Repair I

1-DAY  
TRAINING

### **Training Description:**

This one-day seminar will improve your mechanical skills and give you a better overall understanding of mechanical devices. This is not a seminar on mechanical theory; it is practical applications that can be taken back to your facility for immediate use.

In this seminar you will learn about bearing types and applications as well as removal, installation, numbering systems, and inspection methods.

You will also learn how to reduce costly downtime through proper mechanical maintenance practices. This seminar will not only teach people what to look for in belt/pulley wear, but it will also teach them how to correctly select the proper belt for replacement. Number systems, matched belts, variable speed drives, and notched belts are only a few of the many topics that will be covered. The attendee will learn how to use tools found in the field such as tensioning tools, dial indicators, and others.

### **Training Topics:**

#### **PROPER TOOLS**

- Reading Dial Indicators
- Proper Tools for the Job
- Hand Tool Safety

#### **BEARINGS AND SEALS**

- Terms and Classifications
- Bearing Types and Materials
- Seal Types and Materials
- Operation and Replacement
- Troubleshooting Belt Drive Failure

#### **BELTS**

- Belt Types and Identification
- Numbering Systems
- Pulleys and Sheaves
- Pulley and Sheave Installation
- Proper Alignment and Tension

#### **CLASS DISCUSSION AND REVIEW**

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# HANDS-ON MECHANICAL maintenance troubleshooting & repair II

## Hands-On Mechanical Maintenance Troubleshooting & Repair II

1-DAY  
TRAINING

### **Training Description:**

This one-day seminar will cover not only mechanical devices such as drive chains, sprocket types and selection, and mechanical drive couplers, but, you will also take an in-depth look at proper lubrication, learn about different types of lubricant, and lubrication processes. You will also gain practical knowledge of how, when, and what to lubricate, as well as problems that exist in real world machinery and devices.

Every student in this seminar will assemble, adjust, and learn the proper installation of several types of drive couplers, as well as chain drives, sprocket drive assembly, adjustment, and proper tensioning. Come prepared to roll up your sleeves, learn from a hands-on approach, and gain knowledge that you can put to use the first day back to work.

Whether you are new to mechanical maintenance or have spent 20 years in the field, every attendee can benefit in some way from the training Lewellyn Technology offers.

### **Training Topics:**

#### **DRIVE COUPLERS**

- Types of Drive Couplers
- Proper Installation and Alignment

#### **LUBRICANT**

- Types and Classifications
- Viscosity
- Compatibility
- Common Lubricant Problems

#### **CHAIN DRIVE SYSTEMS**

- Chain Types and Identification
- Numbering Systems
- Sprocket Types and Identification
- Proper Alignment and Tensioning
- Troubleshooting Chain Failure

#### **CLASS DISCUSSION AND REVIEW**



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# CENTRIFUGAL PUMPS

## fundamentals & troubleshooting

### Centrifugal Pumps Fundamentals & Troubleshooting

2-DAY  
TRAINING

#### Training Description:

This program teaches the fundamentals of how and why pumps perform useful work. Attendees will learn how pumps can and do pump a wide variety of fluids in hundreds of different applications. You will learn how a centrifugal pump performs useful work and about the influence piping and valves have on the pump. This program provides the foundation on how to correctly select and size a pump for a given job. It also reveals why so many pumps aren't working properly. In this program you will also learn how to make pumps last longer in many different systems by doing things right the first time the pump is installed. It delivers explanations of why many pump parts fail and what we can do about making them last longer. You will learn why pumps wear out much too fast because of a failure to understand how the pump and the system work together. You will also learn the basic knowledge and tips on performing pump repairs.

#### Training Benefits:

- Understand the difference between closed & open pump systems.
- Reduce energy costs.
- Proper installation & care of pumps.
- Common problems & troubleshooting methods.

**Prerequisite:** None  
**Standard Class Size:** Up to 20  
**Program Length:** 12 hours  
**CEU s:** 1.2

#### Training Topics:

- Industry Standards
- Total Discharge Head
- Pump Efficiency
- Pump Performance Curves
- Types Of Pumps
- Types Of Impellers
- Affinity Laws
- Trimming Pump Impellers
- Net Positive Suction Head
- Constant Speed System Costs
- Variable Speed Pump Operation
- Cost Savings For Variable Speed Operation
- Pump Application Problems
- How An Open Or Closed System Affects the Pump
- How To Properly Install Your Pumps
- Mechanical Seal Troubleshooting
- What To Do When Pumps Cavitate
- What Happens To The Pump When We Throttle a Valve
- How To Deal With Air Entrapment Problems
- What Is Proper Piping For The Pump
- Proper Submergence For The Pump s Intake
- Foundation And Grouting Tips
- The Importance Of Shaft Alignment
- Why Pump Bearings Fail
- Why Pump Parts Wear Out Too Quickly

CLASS DISCUSSION AND REVIEW

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# HANDS-ON pneumatics

## Hands-On Pneumatics

2-DAY  
TRAINING

### **Training Description:**

This powerful interactive training program is designed to give a broad-based understanding of the most important pneumatic concepts. This program will introduce students to the real-world of pneumatic and electro-pneumatic control and power transmission. The state-of-the-art pneumatic training aids we use are designed to allow the student to reinforce the lessons presented by applying standard industrial pneumatic components in at least 18 hands-on exercises. All the hands-on exercises illustrate real-world applications that can be, and are, used on much industrial automated equipment. With this knowledge and practical training students should be able to successfully install, maintain, and troubleshoot pneumatic systems and components.

### **Training Benefits:**

- Increase knowledge of basic components & how they work.
- Better communication with outside contractors.
- Save money by reducing costly downtime.
- Get the hands-on experience.

**Prerequisite:** None  
**Standard Class Size:** Up to 14  
**Program Length:** 18 hours  
**CEU s:** 1.8

### **Training Topics:**

- Basic Physics
- Compressors
- Flow and Pressure
- Bernoulli's Principle
- Pressure Regulators
- Power and Control Valves
- Cylinder Types
- Air Preparation
- Check, Shuttle, and Pulse Valves
- Gauges and Flow Meters
- Vacuum Generation and Applications
- Understanding and Reading Schematics
- Miscellaneous Valves
- Pneumatic Automation

**CLASS DISCUSSION AND REVIEW**



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# HANDS-ON INDUSTRIAL hydraulics

## Hands-On Industrial Hydraulics



### Training Description:

This program has been designed to give you a broad understanding of the most common and important hydraulic components, principles, and concepts. Using top quality presentation materials and simulation, you will be trained by a field experienced, Lewellyn Technology instructor. Upon completion of this program you will have a solid knowledge of all common hydraulic components, the functions they perform in a hydraulic system, and how they interact with other components in the system to get the job you want done. As the program progresses, the more complex components involved in hydraulic systems will be discussed. You will learn about a variety of pumps, valves, and actuators, and how to control them to perform the work you desire. You will learn about proper flow and sizing of hydraulic components, as well as tips you can use for troubleshooting problems in your system. Proper maintenance of hydraulic fluids and system components will also be discussed.

### Training Benefits:

- Understand common symbols with confidence.
- Better communication with outside contractors.
- A well trained department is a safe department.
- Better understanding of fluid conditions.

**Prerequisite:** None  
**Standard Class Size:** Up to 14  
**Program Length:** 18 hours  
**CEU s:** 1.8

### Training Topics:

- HYDRAULIC PRINCIPLES
  - Energy, Inertia, Pressure, Force, Flow, & Horse Power
- HYDRAULIC SYMBOLS
- TWO COMMON MISCONCEPTIONS
- PUMPS
  - Non-positive Displacement
  - Positive Displacement, Principal of Operation
  - Common Fixed Positive Displacement Pumps
- GEAR
- VANE
- PISTON
- CYLINDERS, SINGLE AND DOUBLE ACTING
  - Effect of Differential Area on Force and Speed
- NEED FOR PRESSURE CONTROL
  - Direct Acting Pressure Relief Valves & Reducing Valve
- SPEED CONTROL VALVES
  - Simple Flow Control Valves
- DIRECT ACTING DIRECTIONAL CONTROL VALVES
  - Two-Way, Three-Way, Four-Way, Two and Three Position
  - Common Valve Actuators
- CHECK VALVES
- ACCUMULATORS
  - Types, Applications, Safety Considerations, & Simplified
  - Accumulator Sizing
- HYDRAULIC PUMPS
  - Efficiency, Volumetric, & Overall
  - Variable Volume Pumps
  - Pressure Compensation
  - Selecting Motor to Drive a Pump
    - Effect of Driver Speed
    - Horse Power Requirement
- ACTUATORS
  - Hydraulic Motors
  - 2:1 Cylinders
    - Pressure Intensification
    - Regeneration
- PRESSURE AND TEMPERATURE COMPENSATED FLOW CONTROL VALVES
- PLACEMENT OF FLOW CONTROL VALVES IN A CIRCUIT
  - Meter in, Meter out, Bypass, & Priority
- PILOT OPERATED DIRECTIONAL CONTROL VALVES
- PILOT OPERATED CHECK VALVES
- PRESSURE AND LOAD CONTROL
  - Unloading Valves
    - Accumulator Circuit & Hi-Lo Circuit
  - Sequence Valves
  - Counterbalance Valves
  - Over Center Valves
  - Accumulator Discharge Unloading Valve
  - Need for, and Operation of, Pilot Operated Pressure Controls
- CAUSES & EFFECTS OF HIGH PUMP INLET VACUUM AND SUCTION LEAKS
  - Cavitation, Pseudo-cavitation, & Other Causes of Air Entrainment
- FLUID CONDUCTORS AND CONDUCTOR SIZING
- FLUID CONDITIONING
  - Fluid & Filtration
- CLASS DISCUSSION AND REVIEW



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# MULTI-CRAFT maintenance 101

## Multi-Craft Maintenance 101

3-DAY  
TRAINING

### Training Description:

These 3 days of training will establish a foundation of **core competencies** in electrical, mechanical and safety that every maintenance technician must have to be effective and safe. The goal of this training is to reduce your machine-downtime and accidents.

Our Multi-Craft Maintenance Training Program was designed for you, the modern maintenance technician, who is asked to be a jack-of-all-trades. You must perform electrical and mechanical repairs and remain safe at the same time. This course covers *electrical, mechanical, and safety* topics that help build a great foundation for today's multi-craft maintenance personnel. This is not a course on theory; rather it is practical knowledge that will help you everyday. It is a how-to course on keeping your critical systems up and running.

We have been training maintenance personnel for many years and have applied our practical and award-winning training methods to these courses. During development, our own experienced maintenance personnel asked the question, What tasks do multi-craft maintenance technicians regularly perform and what do they need to know to do their jobs effectively?

We will discuss the proper methods of troubleshooting that will remove the frustration you may currently experience. You will learn the proper use of a multimeter, as well as the half-splitting method. We will show you how to stop being a parts-changer and begin being a troubleshooter by sharing with you our many years of experience.

We will also destroy the myths about electrical safety that often come from learning it through on-the-job-training. Just because an old-timer says, I've done it this way for years and I'm not dead yet, does not mean it is the right way. A wealth of electrical safety knowledge has been gained in recent years, causing improvements and regulatory changes. We will get you up-to-date so you can go home safely after your shift.

### Training Topics:

#### FUNDAMENTALS OF ELECTRICITY

- Ohm's Law
- Electrical Drawings
- Relays & Contactors
- Motor Control Circuits
- Transformers
- Single-Phase Power Distribution
- Three-Phase Power Distribution
- Three-Phase Induction Motors
- Motor Protection
- Motor Starter Heaters
- Fuses
- Fuse Sizing
- Test Three-Phase Motors

#### HANDS-ON ELECTRICAL TROUBLESHOOTING

- Multimeter Basics
- Component Testing
- Resistance Measurement
- Test Fuses
- Test Coils
- Test Contacts
- Test Contactors
- Test Motor Starters
- Half-Splitting Method
- Measure Voltage
- Building Control Circuits
- Procedures for Troubleshooting
- Troubleshooting Circuits
- Repairing Circuits
- Troubleshoot Live Circuits

#### SAFETY

- Safety Attitude
- NFPA 70E Topics of Interest
- Background of 70E
- Qualified vs. Unqualified
- Hazard Analysis
- Shock Hazards
- Arc Flash Hazards
- Approach Boundaries
- Insulated Gloves
- Insulated Tools
- Flash Protection Boundaries
- PPE
- Fire Resistant Clothing (definitions)
- Fire Resistant Clothing Use

#### MECHANICAL

- Bearings
- Lubrication
- Bearing Replacement
- Belt Tension
- Pulley Wear

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# ELECTRICITY

# level I

## Electricity Level I

4-DAY  
TRAINING

### Training Description:

This program is designed to enable an entry level or a cross-trained maintenance person to acquire the skills necessary to become an efficient part of the maintenance team. This course begins with a discussion of the fundamentals of electricity. During this discussion, basic meter safety and proper meter usage are covered. This enables the students to use their meters to see the fundamentals in action while performing hands-on exercises. Electrical Safety is the next subject. OSHA Code of Federal Regulations 1910.332 requires employers to provide electrical safety training for all employees. During this section of the program, students will become familiar with the dangers of current, arc flash, and other electrical hazards. The students will also learn the proper personal protective equipment (PPE) to wear to protect themselves from the hazards. This section of the class includes some graphic material to show the tragic results that can occur when not following proper safety procedures. Single-phase systems are next on the agenda. During this discussion the student will be introduced to grounding, receptacles, series and parallel circuits, as well as hands-on testing labs using heaters and lights. Once the student has a firm grasp of single-phase, there is a brief discussion on three-phase voltages and distribution systems. This area of the class is an excellent primer for Electricity Level II. Maintenance technicians can become frustrated if they have not been properly trained to read the prints and to use them as a troubleshooting tool. During this section of the class, we will show the students how to read basic prints, understand magnetism, relays, contactors, motor starters, and wire components according to a print. We encourage the customer to supply us with a few of their basic prints to incorporate into this section.

### Training Benefits:

- Can help in meeting OSHA regulations for qualified electrical workers.
- A positive image reflected of the company.
- Technical qualifications clearly established.
- A well trained department is a safe department.

**Prerequisite:** None  
**Standard Class Size:** Up to 14  
**Program Length:** 24 hours  
**CEU s:** 2.4

### Training Topics:

#### FUNDAMENTALS OF ELECTRICITY

- Voltage, Current, Resistance, and Meter Basics
- Meter Types
- Categories and Safety
- Voltage Types - Hands-On Labs
- Current and Resistance
- AC vs. DC
- Ohm's Law
- Series and Parallel Circuits
- Calculating Heat Loads

#### ELECTRICAL SAFETY

- Qualified vs. Unqualified
- PPE
- GFCI
- Approach Boundaries & Clearance Distances
- Actual Case Studies

#### SINGLE-PHASE DISTRIBUTION

- Voltage Drops with Heaters - Hands-On Labs
- Voltage Drops with Lights - Hands-On Labs
- Current Measurements in Series and Parallel

#### CIRCUITS HANDS-ON LABS

- 3-Way Switches
- Fluorescent Lights-Ballast Troubleshooting
- Grounding
- Receptacle Types and Loads

#### INTRODUCTION TO THREE-PHASE

- 3-Phase Generation
- 3-Phase Distribution Types
- Delta vs. Wye
- Grounding

#### THREE-PHASE MOTOR PRINT READING

- Drawing Types and Symbols
- Input and Output Devices
- Coils/Solenoids - Hands-On Labs
- Relays
- Hands-On Wiring Labs
- The Motor Starter
- 3-Wire Control
- Print Reading

#### CLASS DISCUSSION AND REVIEW

**REMEMBER:** Attendees should bring a multimeter, preferably the one they use on the job, with them for this hands-on training.



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# ELECTRICITY

# level II

## Electricity Level II

4-DAY  
TRAINING

### Training Description:

This program is a continuation of Level I. Level II takes the basic concepts discussed in Level I and uses them to develop an understanding of more complicated concepts that are necessary to know to effectively maintain and troubleshoot motor control circuits, variable frequency drives, and other complex electrical systems.

This program begins with a brief review of the fundamentals of electricity. Next we move into a detailed discussion of how motors work. We begin with DC motors. During this section, students will connect DC motors to voltages to see the principles in operation. Then our discussion will turn to single-phase AC induction motors, and three-phase AC induction motors, which are considered the workhorse of industry. We will discuss, in detail, and practice, with hands-on exercises, proper motor troubleshooting techniques, including capacitor checks. Article 430 of the National Electrical Code explains specifically how to properly protect different types of motors from overcurrents. We will cover this information from the viewpoint of a troubleshooting maintenance person. What size heaters do I use? During Level I, we covered the basics of electrical print reading. In this section, we will cover more advanced NEMA-style prints (prints generated in the United States), and IEC symbols and prints as well. We recommend including your prints in this section of the program to familiarize the students with the prints they will actually be working with. This program finishes with two to three days of very intense hands-on troubleshooting. We use actual motor control circuits and components. The students will hard wire motor control circuits, make them work, and then the instructor will insert real-world faults. No, we do not use banana plugs or switches to simulate faults. The students will then have to apply the troubleshooting techniques taught by the instructor to repair the circuits. Many students tell us that this section of the program is like a week at work.

### Training Benefits:

- Investing in employee skills can reduce operation costs & downtime.
- Applicable skills available upon return to the workplace.
- Reflects a positive image of the company.
- Pre & post testing can help establish baseline skills.

**Prerequisite:** Electricity Level I  
**Standard Class Size:** Up to 14  
**Program Length:** 24 hours  
**CEU s:** 2.4

### Training Topics:

#### REVIEW OF FUNDAMENTALS OF ELECTRICITY

- Voltage, Current, Resistance, and Power
- #### DC MOTORS

- DC vs. AC Motor Comparison
- Basic Magnetic Field Theory
- Terminology
- Nameplate Information
- Operation & Troubleshooting

#### SINGLE-PHASE AC INDUCTION MOTORS

- Motor Nameplate Information
- Motor Operation, Rotation, and Connectors
- Capacitor Troubleshooting

#### THREE-PHASE AC INDUCTION MOTORS

- Operation & Enclosures
- Nameplate Information
- Overcurrent Protection
- Locked Rotor Amps
- Ground Fault/Short Circuit Protection Sizing
- Fuse Data and Circuit Breaker Operation
- Motor Starter Sizing
- Overload Protection Sizing

#### ADVANCED PRINT READING

- Symbol Laws and Facts
- Advanced Input and Output Devices
- Print Numbering Standards
- Reading Real-World Prints
- IEC Symbols
- Troubleshooting Using Prints

#### HANDS-ON ELECTRICAL TROUBLESHOOTING

- Continuity
- Testing Relays
- Photo Cells
- Motor Starter
- Troubleshooting Methods
- Troubleshooting Three-Phase Motor
- Troubleshooting Motor Control

#### CLASS DISCUSSION AND REVIEW

**REMEMBER:** Attendees should bring a multimeter, preferably the one they use on the job, with them for this hands-on training.

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# AUTOMATION

# level I

## Automation Level I

4-DAY  
TRAINING

### **Training Description:**

This program is designed for an entry level maintenance person or a seasoned veteran who is already familiar with motor controls. Whether your work involves facility maintenance, production maintenance or HVAC controls, automation plays a key role. This program begins with an overview of different types of sensors including thermocouples, RTDs, photo-electric devices, capacitive proximity switches, inductive, proximity switches, and introduction to programmable logic controllers. Regardless of the manufacturer, PLCs have four basic parts which include the power supply, the central processing unit, the input/output section, and some type of programming device. We will break down each of these key components in a basic, easy to understand format. We will concentrate on understanding the sections from a troubleshooter's aspect. During the discussion, different brands of PLCs will be introduced to show how similar they are to each other. Once the student fully grasps the basics, then the course continues to accelerate. The input/output section is examined in greater detail.

### **Training Benefits:**

- Technical qualifications are clearly established.
- Safer work environment; trained workers have less accidents.
- Reflects a positive image of the company.
- Applicable skills are available upon return to the workplace.

**Prerequisite:** None  
**Standard Class Size:** Up to 14  
**Program Length:** 24 hours  
**CEU s:** 2.4

### **Training Topics:**

#### TEMPERATURE SENSORS

- Thermocouples
- RTDs

#### PHOTO-ELECTRICS

- Reflective
- Retro-Reflective
- Diffused
- Fiber Optics
- Troubleshooting Tips

#### PROXIMITY SWITCHES

- Inductive
- Capacitive
- Ultra-Sonic
- Troubleshooting Tips

#### PLCs

- Advantages of PLCs
- Basic Component Operation
- Input/Output Modules
- Ladder Logic vs. Ladder Diagrams
- Hardware Troubleshooting
- Common Instructions
- Timers
- Counters
- Addressing
- Troubleshooting Using the Program
- Troubleshooting Without Documentation

#### HANDS-ON PLC LABS

- One Output with One Input
- Logic Change
- Two Outputs with One Input
- Three-Wire Control with a Motor Starter
- Add Auxiliary Contacts
- Light On When Running
- Light On When Not Running
- Timers/Counters
- Proximity Switches
- Hands-On Wiring of All Components
- Hands-On Troubleshooting During Labs

#### CLASS DISCUSSION AND REVIEW

**REMEMBER:** Attendees should bring a multimeter, preferably the one they use on the job, with them for this hands-on training.

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# AUTOMATION

# level II

## Automation Level II

4-DAY  
TRAINING

### **Training Description:**

This program is designed for maintenance personnel that already have a working knowledge of PLCs and are familiar with relay logic. The majority of this class is spent working hands-on with PLCs and motor drives.

The leader in PLC applications in the United States is Allen Bradley. We utilize SLC 5/02 processors and RSLogix software in our hands on programming section. The student is first introduced to the common screens of both RSLogix™ and RSLinx™. Once the student is familiar with the common screens the class advances to entering simple programs, monitoring these simple programs, and modifying/editing the existing programs. As the program progresses the labs become more complex. The students are encouraged to work at their own pace while being assisted by the instructor. The students are shown how to recover from a power failure, upload and download programs, and set up reporting for troubleshooting when the need arises.

### **Training Benefits:**

- Investing in employee skills can reduce operation costs & downtime.
- Certifications are issued with no extra cost.
- A well-trained department is a safe department.
- Applicable skills are available upon return to the workplace.

**Prerequisite:** Automation Level I

**Standard Class Size:** Up to 14

**Program Length:** 24 hours

**CEU s:** 2.4

### **Training Topics:**

PLC BASICS

BASIC INSTRUCTIONS

FILE TYPES

- Program Files
- Data Files

ADDRESSING

INTRODUCTION TO RSLOGIX™ SOFTWARE

INTRODUCTION TO RSLINX™ SOFTWARE

INITIAL COMMUNICATION SETUP WITH THE COMPUTER

CONFIGURING COMMUNICATION DRIVERS

CREATING A NEW PROJECT

I/O CONFIGURATION

CHANNEL CONFIGURATION

CREATING AND EDITING THE LADDER

OVER 20 HANDS-ON LABS INCLUDING:

- Examine On vs. Examine Off
- Internal Bits
- Status Bits
- Timers
- Counters
- Move Instructions
- Data Monitor
- Understanding I/O Lights
- Histogram
- AC vs. DC Motors & Controls
- AC Variable Frequency Drives
- AC Induction Motors
- Inverter Duty vs. Standard Duty Motors
- Basic Set Up Parameters
- Operating Parameters
- How to Monitor the Correct Information
- Safety Precautions
- Troubleshooting Drive Systems
- Motor Problems vs. Control Problems vs. Drive Problems
- Many Hands-On Labs with Troubleshooting Problems
- Using Your Meter to Distinguish Between Motor Problems and Drive Problems

CLASS DISCUSSION AND REVIEW

**REMEMBER:** Attendees should bring a multimeter, preferably the one they use on the job, with them for this hands-on training.

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# HOISTING and rigging

## Hoisting and Rigging

3-DAY  
TRAINING

**Prerequisite:** None  
**Standard Class Size:** Up to 15  
**Program Length:** 18 hours  
**CEU s:** 1.8

### **Training Topics:**

#### **INTRODUCTION TO RIGGING SAFETY:**

- Accident causes
- Personal safety equipment hardhats, steel-toed shoes, gloves, etc
- Proper clothing and gear
- Personal lifting techniques
- Special considerations electrical hazards, trip and fall environment, confined space, etc.

#### **HOW TO CALCULATE THE WEIGHT OF A LOAD**

- Load rating tables
- Effects of load angle
- How to lift the load
- Communications and signals
- Dynamometers

#### **RIGGING HARDWARE**

- Types

#### **SLINGS**

- Usages - pros and cons
- Good and bad practices
- Inspections

#### **HITCHES**

- Purpose and use of each hitch
- Hitch limitations
- Load limitation
- Load rating tables
- Inspections

#### **ROPES**

- Types and purpose
- Handling and care

#### **MECHANICAL ADVANTAGE**

- Overhead cranes
- Mobile cranes
- Jib cranes
- Gin poles
- A-frames
- Come-a-longs
- Chain hoists
- Force vectors
- Pulley Systems

#### **CLASS DISCUSSION AND REVIEW**



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# NATURAL GAS distribution maintenance

## Natural Gas Distribution Maintenance

2-DAY  
TRAINING

### **Training Benefits:**

- Better understanding of maintenance procedures for gas systems
- Safer work environment, trained workers have less accidents
- Reduce costs with expensive downtime
- Applicable skills available upon return to the workplace

### Hands-On Session Testing (optional)

This will be 8 hours of actual cutting, threading, and welding of steel pipe, butt fusion and saddle fusion of plastic pipe as well as the tools and techniques of both.

**Prerequisite:** None  
**Standard Class Size:** Up to 14  
**Program Length:** 16 hours  
**CEU s:** 1.6

### **Training Topics:**

#### **INTRODUCTION AND OVERVIEW**

- ATTENDEES INTRODUCTION
- OBJECTIVES AND CONTENTS OF THE COURSE
- USAGE OF NATURAL GAS

#### **GENERAL SAFETY PRACTICES**

- SAFETY EQUIPMENT
- OSHA REGULATIONS AND GUIDELINES
- NEW YORK STATE CODE REQUIREMENTS

#### **PHYSICAL PROPERTIES OF NATURAL GAS**

- ORIGIN
- PROCESSING AND INGREDIENTS
- HEATING VALUE AND SPECIFIC GRAVITY
- GLOSSARY OF TERMS
- PRESSURE RATINGS

#### **MATERIALS OF CONSTRUCTION**

- TYPES OF MATERIALS
- METHODS OF JOINING GAS PIPING
- DESIGN OF DISTRIBUTION SYSTEMS
- DESIGN OF INTERIOR PIPING SYSTEMS

#### **CORROSION**

- DEFINITION
- TYPES OF CORROSION
- METHODS OF PROTECTION

#### **MAINTENANCE**

- PREVENTATIVE MAINTENANCE PROGRAM
- GAS LEAKS
- GAS PRESSURE REGULATOR
  - OPERATION
  - MAINTENANCE
  - REPAIR

#### **CLASS DISCUSSION AND REVIEW**

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# INSTRUMENTATION & process control basics

## Instrumentation & Process Control Basics

3-DAY  
TRAINING

**Prerequisite:** None  
**Standard Class Size:** Up to 15  
**Program Length:** 18 hours  
**CEU s:** 1.8

### **Training Topics:**

#### **INTRODUCTION**

1. COURSE OBJECTIVES
2. MATTER AND ITS PROPERTIES
3. BASIC PHYSICS
4. ENERGY
5. MEASUREMENT
6. SAFETY

#### **PROCESS VARIABLES**

1. PROCESSES, VARIABLES AND FUNCTION OF INSTRUMENTS
2. TEMPERATURE
3. WEIGHT
4. PRESSURE
5. FLOW
6. LEVEL

#### **DIRECT-READ INSTRUMENTS**

1. PRESSURE
  - A. GAUGES
  - B. BOURDON TUBES
  - C. MANOMETERS
2. LEVEL
  - A. FLOAT
  - B. DIFFERENTIAL PRESSURE
3. FLOW
4. TEMPERATURE
5. WEIGHT

#### **ELEMENTS OF CONTROL SYSTEMS**

1. BASIC FUNCTION OF CONTROL SYSTEMS
  - A. CONTROL STEPS
  - B. CONTROL LOOPS
  - C. INPUT /OUTPUT
  - D. TYPES OF SIGNALS
2. BASIC ELEMENTS OF CONTROL LOOPS
  - A. SENSORS
  - B. INDICATORS AND RECORDERS
  - C. FLOW TRANSMITTERS
  - D. CONTROLLERS
  - E. FINAL CONTROL ELEMENTS

#### **CLASS DISCUSSION AND REVIEW**

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# MEET OUR instructors

An industry total of **over 260 years experience** on the plant floor is what our instructors bring to our training. That experience means practical, realistic maintenance situations are used as examples during our courses. We prepare your maintenance technicians to use this knowledge when they return to your facility. Our instructors have gained experience on the plant floor from industries such as TRW, Bemis, Great Dane Trailers, Copeland, Caterpillar, Amtrak, Inland Steel Company, Allen-Bradley, Furnas, and General Electric.

Their educational background is extensive and varied. Degrees from Indiana State University, Indiana Vocational Technical College, Indiana University, Purdue University, Vincennes University, Southern Illinois University, Eastern Illinois University all combine to make our instructors some of the best in the business. Some of our instructors have even taught college level classes on topics such as Basic Industrial Electricity, Electromechanical Controls, and Programmable Controls.

Membership in various associations lends in-service updates as well: National Fire Protection Association (NFPA), National Electric Code (NEC), The American Water Works Association, American Society for Training and Development (ASTD), Tesla Society, Instrument Society of America, Association of Supervision and Curriculum Development, and the Indiana Electric League.

Extensive maintenance experience, educational background, memberships in professional societies and affiliations, and continuing education of all our instructors is the winning combination that contributes to the success of Lewellyn Technology.



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# MEET OUR instructors

## **DARYN LEWELLYN**

Daryn founded Lewellyn Technology 16 years ago and has watched it grow into the premier electrical safety company in the nation. Daryn's background is in manufacturing where he worked in maintenance for companies like Bemis and TRW. He has been teaching and developing training programs for over 19 years and spends most of his time now speaking on electrical safety at conferences, seminars, and corporate safety meetings, as well as consulting with clients in their facilities. He has had many articles published on topics such as Electrical Troubleshooting, NFPA 70E, and Arc Flash. He takes great pride in knowing his company has helped hundreds of thousands of people improve their workplace safety and performance.

## **ANDY RUBENACKER**

Andy Rubenacker joined the Lewellyn team with over 20 years experience in the maintenance field. Over the course of his career Andy has worn many hats, including: maintenance technician for Inland Steel Coal Company; maintenance technician for Precision National Corporation; electrical/instrumentation technician at Indian Oil Refining (and later becoming a supervisor and trainer for the department). These positions required skills in welding, pneumatics, hydraulics, electronics, electricity, and mechanical maintenance. He has repaired overhead cranes, welders, production equipment, steamboilers and HVAC, and is a certified electrician in high, medium, and low voltage from the U.S. Department of Labor and Mine Safety. He also has experience with PLCs and digital control systems. Andy holds a degree in Education from Southern Illinois University, and an additional degree from Eastern Illinois University in Education. He has also attended training seminars by Bailey Control Company, John Brown Engineers, and U.S. Department of Labor.

## **BOB KORENICH**

Bob Korenich has been with Lewellyn Technology for the last 9 years. He received electronics training while serving in the U.S. Marine Corps and also participated in the electrical apprentice program at Inland Steel Company. While working as an electrician for the city of Bloomington, Indiana utilities department, Bob maintained the electrical systems for two sewage treatment plants and two fresh water treatment plants, as well as sewage lift stations and water booster pump stations. He also worked as an electrical assembler for the Micro Poise division of the Ransburg Corporation in Indianapolis. Bob also spent 18 years testing and troubleshooting locomotives while working as a diesel-electric locomotive technician for Amtrak. He worked on every single Amtrak locomotive in operation at that time.

## **CARL SCHMIDT**

Carl received his first electrical training in the U.S. Navy. He served eight years as a nuclear trained electrician on submarines, including nearly four years as a crew member of the deep submersible submarine, NR-1. Carl worked for five years in the sensor industry, first as a technician, and then as a design engineer after graduating with a B.S. EET degree from DeVry. He primarily worked with optical sensors and encoders. Before joining the Lewellyn Team, Carl worked at Nucor Steel for more than 11 years, first as a maintenance engineer, then as a maintenance supervisor. He has worked with 34.5 KV, 4160 V, and 480 VAC distribution equipment. He's also worked with AC and DC motors and drive equipment to 10,000 HP, PLC's, and many other types of automation and control equipment.



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# MEET OUR instructors

## **GARY SCHILTZ**

Gary joined Lewellyn Technology in the fall of 2000 as a full-time instructor. He had spent the last 25 years working in a variety of positions in the Electrical field. Most recently he was an Associate Process Design Engineer with Mannesman VDO in Auburn, Ind. In that position he was responsible for production line layouts, equipment specification, and machine design. Prior to that position he was in the Maintenance Department as a Senior Electrical Maintenance Technician for 11 years. Mannesman VDO was previously Philips Technology, and prior to that was known as Magnavox Industrial Corp. They were automotive sensor and control device manufacturers. In his maintenance position he was tasked with machine repairs, modifications, and design. He has also been a part-time Instructor at Ivy Tech State College for many years teaching Electrical Controls and PLC's. Gary has an Associates Degree in Electrical Engineering Technology from ITT Technical Institute.

## **JAY SMITH**

Jay Smith came to Lewellyn Technology, Inc. with over 31 years of experience in electrical and mechanical maintenance with Peabody Coal Company. Jay is a federally Certified Master Electrician in Low, Medium, and High Voltage through MSHA. He holds an associates degree in electrical technology and has a strong knowledge in electrical theory and math. He has maintained the world's largest coal excavating dragline in the world. This dragline is a DC machine, which has given him a very solid troubleshooting and practical knowledge in AC & DC relay logic. Jay has worked with voltage from 0-345 KV. Maintained all of Peabody's powerlines, substations, and switchgear. Designed and built the electrical controls (power & control) for vertical twin mast (12") overburden drills. Repaired and maintained cranes (AC & DC), welders, VersiMatics, wire, submergible, etc. He has worked as a motor rewinder in a transformer rebuilding shop and as a motor controls troubleshooter. Since Jay's experience varies from using low voltage hookups when troubleshooting PLC's to splicing 345 KV lines, he has an excellent safety record and a great deal of safety knowledge.

## **ROGER ZIEG**

Roger graduated from Western Iowa Technical Community College majoring in the electrical trades. He is a licensed contractor and master electrician in the states of Iowa and Nebraska. Roger has done electrical work in areas including construction, residential, agricultural, commercial, and industrial settings. Before joining the Lewellyn Team, Roger worked for C & S Products, Kellogg Cereals, Cargill, The City of Manson, Iowa, The City of Council Bluffs, Iowa, and Davis International. Roger has taught electrical classes for Iowa Central Community College, Iowa Western Community College, and Metro Community College in Omaha, Nebraska. He is a member of the International Association of Electrical Inspectors (IAEI), NFPA, and an authorized 10 and 30 hour OSHA instructor.

## **STEVE GARSTANG**

Steve Garstang, Professional Engineer, brings over 30 years experience with electric motors and controls. Steve holds an electrical engineering degree from Purdue University and is a registered Professional Engineer in the State of Indiana. He has worked for Allen-Bradley as a sales and applications engineer. Steve also served as a consultant, designing and manufacturing electrical control panels. When we snatched Steve from Copeland, he was serving as an application-engineering manager. He is the author of Electric Motor Controls and Circuits, a publication allowing the use of his extensive knowledge in electric motors and controls. While with Copeland, Steve served on the electrical subcommittee of the Air Conditioning and Refrigeration Institute. His background in refrigeration and air conditioning compressors will be an added benefit in the development of several new classes being offered in the near future. Steve also developed a Lewellyn favorite known as "Lewie's Little Electrical Reference Guide".



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