



Live training onsite, online, or at a seminar near you.

2018 Course Catalog



About TPC Training

We are the leader in live maintenance training. We deliver more than 2,000 courses each year on 30+ electrical, HVAC, plant management, and mechanical topics.

Our intensive 2-4 day seminars are available in more than 150 cities in the US; we also provide live on-site training, tailored to each client's needs and equipment.

As a division of TPC Training, we are an essential part of the total training solution for a better, safer, more efficient workforce.

About Our Instructors

Our team of 60 field-experienced instructors is the backbone of our training schedule. All of our instructors must meet three core requirements: 1) Relevant formal education in the seminar topic area, 2) Documented hands-on work experience in their area, and 3) Specific experience as a maintenance training instructor. Together our instructors have logged more than 200,000 hours of classroom time.

No-Risk Registration and Money-Back Guarantee

Not sure whether you or your employees will be able to attend an upcoming class? You can reserve your space in the class without risk. While payment is due prior to the start of the seminar, there is no penalty for cancellations made at least 24 hours in advance of the seminar start time. If you're not satisfied with the course, we'll promptly refund your payment.

Training at Your Facility

About one-third of our customers choose to take advantage of our on-site option. For larger groups in need of training on a particular topic, on-site training offers several advantages:

- Cost savings for larger groups
- Content tailored to your facility and equipment
- Reduced travel time and expense
- Flexible scheduling

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Air Conditioning & Refrigeration

CEUs: 1.6

Length: 2-Days

Course Description

Being able to understand, operate, maintain, and troubleshoot your own air conditioning system is what this HVAC course is all about. It was created to bring students up to speed in their skills and knowledge as quickly and safely as possible. Taught by instructors who have been in the technicians' shoes, the practical, commonsense approach we take in presenting this course makes it perfect for novice technicians and experienced HVAC technicians alike. This air conditioning and refrigeration training course is designed for anyone who needs to understand basic operation, maintenance, and troubleshooting of air conditioning and refrigeration systems in order to improve efficiencies and uptime in commercial, industrial, or residential locations.

Workshop Option

This course can be combined with our 'Basic Electricity for the Non-Electrician' for a complete 4-Day workshop.

Day 1 Discussion Topics:

Day One of this air conditioning and refrigeration training provides a broad introduction to air conditioning and refrigeration systems, including every-day operation & important refrigerant safety practices. The course is a great overview for maintenance technicians, multi-craft tradespeople, building managers, HVAC technicians or anyone who wants to improve their AC&R operation and maintenance skills. The goal of the first day of this training course is to understand basic AC&R operation & how to properly handle EPA regulated refrigerants.

Fundamentals of AC&R

- Air Conditioning vs. Refrigeration
- Laws of Thermodynamics and Heat Transfer

Regulation, Codes and Standards

- New Energy Efficiency Standards (S.E.E.R.)
- EPA Section 608 of the Clean Air Act
- ASHRAE, ASME
- Technician Licensing, Testing and Certification

Compression Refrigeration Cycle

- Basic System Design
- Follow-the-Heat™

Refrigerants

- CFCs, HCFCs, HFCs, Inorganics
- Zeotropic and Azeotropic Refrigerant Mixtures
- Refrigerant Safety Including R-410a
- EPA 608 Significant New Alternative Policy

Refrigerant Oils

- MO, AB, POE, PAG, PAO Oils & Properties
- Maintaining Oil Quality in Your AC&R System

Major AC&R System Components

- Evaporator, Compressor, Condenser
- Metering (Expansion) Device

EPA 608 Technician Certification Testing

Testing for the EPA 608 Technician Certification is optional. Section 608 of the Federal Clean Air Act requires that all persons who maintain, service, repair, or dispose of appliances that contain regulated refrigerants be certified in proper refrigerant handling techniques by passing the EPA 608 Technician Certification exam.

Day 2 Discussion Topics:

Day Two of the air conditioning and refrigeration training is for people who already have a good foundation in AC&R components and systems. Students are taught common practices (and some "tricks-of-the-trade") for general operation and maintenance of their AC&R systems. They will learn about maintenance schedules and servicing, system diagnostics, troubleshooting, and fine tuning to gain maximum efficiency. Overall, we will help you get the maximum life out of your AC&R systems while keeping it up and running as efficiently and consistently as possible.

Auxiliary System Components

- Crankcase Heater
- Suction Accumulator
- Receiver
- Filter-Drier
- Sight Glass with Moisture Indicator
- Oil Separator
- Service Valves
- Refrigerant Controls

AC&R Electrical Control Circuits

- Electrical Controls and Components
- Relays and Contactors
- Thermostats

Refrigeration Systems

- Commercial Refrigeration and other Specialty Systems

System Diagnostics, Servicing, and Troubleshooting

- Service Tools and Leak Detection Equipment
- Manifold Gauge Set
- Recovery Machine
- Vacuum Pump
- Micron Gauge
- Recovering Refrigerant
- Charging the AC&R System
- Troubleshooting AC&R System Problems
- Energy Conservation & Operating Efficiency

Air Handling Systems

- Psychrometrics – the Study of Air
- Fans and Filters

Heat Pumps and Chillers

- Air, Water, and Ground-Source Heat Pumps
- Heat Pump Operation and Troubleshooting
- Chilled Water System Design and Operation

Boiler Operation, Maintenance, & Safety

CEUs: 1.6

Length: 2-Days

Course Description

This Boiler Operation, Maintenance, & Safety training seminar was designed to take the mystery out of wondering if your boiler is safe and operating efficiently, and provides maintenance technicians and others the confidence and comfort level needed for operating and maintaining their boilers. For the novice technician needing a well-rounded education and the experienced stationary engineer who needs a refresher course for continuing education, this training program provides a no-nonsense, practical and real world approach for boiler operation, maintenance, and safety. Overall, this program is designed to extend boiler life, improve boiler efficiency, and save energy costs for the employer, while establishing a culture of safe work practices among the employees.

Workshop Option

This course can be combined with our 'Air Conditioning & Refrigeration' for a complete 4-Day workshop.

Day 1 Discussion Topics:

Day One of the Boiler Operation, Maintenance, & Safety training provides a broad introduction to boilers, including every-day operation & important safety practices. The course is a great overview for maintenance technicians, multi-craft tradespeople, building managers, stationary engineers or anyone who wants to improve their boiler maintenance and operation skills. The goal of the first day of this Boiler Operation, Maintenance, & Safety training course is to understand basic boiler operation & safety.

Boiler Fundamentals

- Firetube Boilers
- Watertube Boilers
- Cast Iron Boilers
- Low and High Pressure Boilers
- Steam Boilers
- Hydronic Boilers

Fundamentals of Combustion and Heat transfer

- Theory of Combustion
- Thermodynamics
- Steam Tables

Burner Operation and Control

- Gas and Oil Trains
- Standard Burner
- High Turndown Burner
- Burner Controls

Boiler Operation and Testing

- Operator Licensing and Certification
- Start-Up and Shut-Down
- Normal Operation
- Valve Types
- Safety Valves
- Low Water Cutoff Controls

Boiler Room Safety

- Boiler Accidents
- Cause and Effect

Cause and Effect Case Study

- Safety Valves
- Confined Spaces
- Lockout/Tagout

Day 2 Discussion Topics:

Day Two is for students who have already taken Day One, or already have a good foundation in boiler operation and safety. In this second day, students learn about important inspection, maintenance, and burner efficiency practices for their commercial, industrial, and utility boiler systems. Construction design standards, boiler inspections, operating control testing, and general troubleshooting tips will all be discussed. The second day of this program will help you get the maximum life out of your boiler while keeping it running as efficiently and safely as possible.

Construction and Design Standards

- ASME Codes
- NFPA Codes
- NBIC Code

Controls and Safety Devices for Automatically Fired Boilers

- Water Level Control
- Temperature Control
- Pressure Control
- Fuel Train

Inspection and Maintenance of Commercial and Industrial Boilers

- Fireside
- Waterside
- Burner
- Auxiliary Equipment

Boiler and Burner Efficiency

- Heat Exchanger Efficiency
- Combustion Efficiency
- Efficiency Tests
- Condensate Return
- Steam Traps

Troubleshooting

- Burner
- Controls
- Additional

HVAC Electrical Controls & Air Distribution

CEUs: 1.6

Length: 2-Days

Course Description

Controlling air distribution for the comfort of the people in it is one way to ensure an efficient workplace. Designed for any worker involved in air distribution systems, this seminar will take students from the basics of HVAC electrical controls through air distribution and troubleshooting.

Overall, this HVAC Electrical Controls & Air Distribution training program is designed to teach students how to “control” their electrical controls and use fundamental air distribution principles for achieving consistent HVAC comfort and efficiency in buildings, plants, and facilities.

Day 1 Discussion Topics:

HVAC system problems can be divided into three major categories – Air Distribution, Electrical, or Mechanical. The part that causes most service headaches is the electrical portion and most of that can be traced back to control problems. Day One of this Electrical Controls & Air Distribution seminar concentrates on overcoming the most common service problems encountered in HVAC systems by teaching students to understand, troubleshoot, and test HVAC electrical controls.

Basic Electricity

- Basic Electricity & Ohm’s Law
- Meters and Tools for Taking Electrical Measurements
- Electrical Circuits: Series & Parallel

Control Circuits

- Schematics
- Ladder Diagrams
- Developing Wiring Diagrams

Controls

- Overloads
- Relays
- Contactors
- Control Transformer
- Starting Relay
- Defrost Timer
- Thermostat
- High Pressure Control
- Low Pressure Control
- Oil Pressure Control

Troubleshooting

- General Troubleshooting Techniques
- Common Problem Areas
- Commercial Air Conditioning
- Heat Pump Control
- Pump Down Cycle

Day 2 Discussion Topics:

Many common problems found in HVAC systems are relatively easy to correct, but are often overlooked. These problems are not electrically related at all even though many times we can get tricked into thinking they are. Yet a non-electrical problem can be as frustrating to find and fix as an electrical one, and may be even more discomforting to the people who have to live with it. In Day Two of this Electrical Controls & Air Distribution training program we’ll help you eliminate the complaints of “too hot”, “too cold”, “not enough air”, or “I feel a draft”, by concentrating on the most often overlooked and ignored problems in HVAC systems – the “V” in “HVAC” – or ventilation, air distribution, and air balancing!

Determining and Improving Air Flow

- 400 cfm per Ton
- How Many Square Feet per Ton?
- Air Mixture at the Cooling Coil

Exhaust Air

- Positive Pressure
- Negative Pressure

Make-Up Air

- Positive Pressure
- Negative Pressure
- Conditioning the “Make Up” Air

Troubleshooting the Air Distribution System

- Temperature Difference Across the Coil
- Balance in the System
- Short Cycling
- Duct Sizing
- Noise
- How to Use a Ductulator

Water Treatment for Boilers, Chillers, & Cooling Towers

CEUs: .8

Length: 1-Day

Course Description

While much planning goes into designing, installing, and maintaining your facility's HVAC/R system, often little thought goes into water treatment of that system. This one day seminar on Water Treatment for Boilers, Chillers, & Cooling Towers is designed to help your employees overcome that. Precise planning can prevent serious operational problems and ensure system longevity.

Day I Discussion Topics:

Boiler and Steam Waterside Problems

- Scale
- Corrosion and Pitting

Cooling Tower Problems

- Scale
- Corrosion
- Biological Fouling

Properties of Water

- Dissolved Gases and Minerals
- Dissolved and Suspended Solids
- Stability Index

Water Chemistry

- pH
- Alkalinity
- Hardness
- Chlorides
- Conductivity
- Cycles of Concentration

Pre-treatment Methods

- Sodium-Zeolite Water
- Dealkalization
- Deaeration
- Filtration

Post-Treatment Methods

- Chemicals for Boiler Water
- Chemicals for Cool Water

Freeze Protection for Closed-Loop Systems

- Ethylene Glycol
- Propylene Glycol

Water Treatment Equipment

- Selection
- Installation
- Maintenance

Controlling Water Treatment Program Costs

- New Technologies for Old Systems

Vendor Selection and Accountability

Chilled Water Systems

CEUs: 1.6

Length: 2-Days

Course Description

Whether your chilled water system keeps people or equipment cool, this seminar will help students learn how to keep it running efficiently. Students will learn about components used in chilled water systems, uses and applications of chilled water systems among many other things. This seminar is perfect for anyone looking to increase their knowledge about chillers, cooling towers, and other chilled water systems.

Day 1 Discussion Topics:

Day One examines the basics of chilled water systems including chillers and cooling towers. We'll do an overview and review heat theories so students understand why things happen.

Chilled Water Systems Overview

- Introduction
- Component Tasks
- System Design
- Controls
- Codes and Standards

Heat Transfer Theory

- Properties Of Matter: Solid, Liquid, Vapor
- Laws Of Thermodynamics
- Heat Transfer Theory:
 - Conduction
 - Convection
 - Radiation
 - Evaporation
- Principles of Heat and Temperature Measurement
- British Thermal Unit, Specific Heat
- Sensible Heat Latent Heat, Superheat
- Gas Laws
- Atmospheric Pressure, Vacuum
- Pressure/Temperature and Pressure / Volume Relationships

Compression Refrigeration Cycle

- Refrigeration Cycle, Change of State of Refrigerant
- Heat Transfer Within the Refrigeration Cycle
- Follow-the-Heat™

Day 2 Discussion Topics:

Day Two introduces advanced topics such as refrigerants and equipment components, heat rejection systems and principles of heat movement.

Refrigerants

- Refrigerant Composition, Including New Blends
- Refrigerant Oils
- Refrigerant Handling: Recovery, Recycling, Reclamation

Equipment Components

- Compressors: Reciprocating, Scroll, Screw, Rotary, Centrifugal
- Evaporators: Tube-In-Shell, Tube-In-Tube, Coil-In-Shell
- Condensers: Water-Cooled, Air-Cooled, Evaporative
- Metering Devices:
 - Thermostatic Expansion Valve
 - Electronic Expansion Valve
 - High and Low Side Floats
 - Auxiliary Refrigeration Equipment

Heat Rejection Systems

- Cooling Towers
- Evaporative Coolers and Condensers, Heat Exchangers
- Cooling Tower Operation and Maintenance
- Water Chemistry for Open and Closed Re-Circulating Systems
- Glycol Systems and Fluids

Psychrometrics

- Principles of Air Movement
- Wet-Bulb and Dry-Bulb Temperatures
- Relative Humidity and Dew Point Temperatures
- Psychrometric Chart Exercises

Basic Electricity for the Non Electrician

CEUs: 1.6

Length: 2-Days

Course Description

This basic electrical training seminar provides the foundation of electrical knowledge for our students. It includes hands-on skills improvement and is specifically designed for maintenance technicians and other non-electrical personnel working in industrial plants and commercial buildings. It is also a great refresher for experienced electricians and engineers. The goal of this basic electrical training course is to teach students how to reduce equipment downtime, improve overall efficiency and safety, and fix problems they've been unable to solve on their own. This course can also be adopted as part of a company's regular Qualified Electrical Worker program.

Workshop Option

This course can be combined with our 'Electrical Troubleshooting & Preventive Maintenance' for a complete 4-Day workshop.

Day 1 Discussion Topics:

In Day One – “Understanding Industrial Electricity” – students will gain a basic understanding of how electricity works in commercial and industrial settings. Starting with easily understood analogies to explain the fundamentals of electricity, students are then quickly immersed in practical, real world examples that illustrate how electricity is distributed and used in their plants and facilities. They'll learn how to use electrical test equipment in their everyday jobs before moving on to an in-depth discussion about major electrical components, where & how these components work, and their purposes within electrical systems.

Electrical Fundamentals

- Production & Distribution of Electricity
- DC and AC in Plants and Facilities – Hands-on Exercise
- Voltage, Current, and Resistance; Ohm's Law
- Basic Electrical Circuits: Series/Parallel – Hands-on Exercise
- Power: Types and Control
- Single-phase and Three-phase Systems
- Workplace Electrical Safety

Electrical Test Equipment

- Multimeters – Hands-on Exercise
- Voltage Testers

Verifying a Circuit De-energized – Hands-on Exercises

- 3 Modes of Failure: Opens, Shorts, and Ground Faults
- Clamp-on Ammeter, Megohmmeters, and Others

Understanding Your Building Electrical System

- Reading Electrical Single-Line Diagrams
- Major Components
- The Electrical Service
- Main Distribution Centers
- Transformers
- Switchgear and Circuit Breakers
- Overcurrent Protective Devices
- Feeders
- Disconnects
- Motors – Hands-on Exercises
- Panelboards and Branch Circuits
- Lighting Circuits
- Electrical Floor Plans & Facility Wiring

Day 2 Discussion Topics:

In Day Two – “Working with Industrial Electricity” – discussions and activities focus on real world, everyday electrical tasks performed on the job. Students will receive a short introduction to NFPA 70E® and the National Electrical Code® as the starting point for all electrical work. Next they will learn how to choose the right materials for the job and how to perform basic electrical repairs and installations. A discussion on proper wiring will be followed by practical tips for electrical troubleshooting. The day will end with an overview of other common electrical work activities such as preventive maintenance.

NFPA 70E® Electrical Safety

- Hazards and Dangers of Electricity
- Personal Protective Equipment (PPE)
- Lockout/Tagout (LOTO)
- Developing Safe Work Practices

The National Electrical Code®

- Purpose, Overview, and Definitions
- Installation Requirements
- “Qualified Electrical Workers”

Wire Selection

- Conductor Types & Materials
- Wire Size and Wire Insulation

Installing Wire (Conductors)

- Raceways and Cable Trays
- Conduits
- Fittings and Boxes

Wiring Equipment – Hands-on Exercises

- Wire Nuts, Terminals, and Crimpers
- Switches and Receptacles
- Fluorescent Ballasts
- Motors
- Temporary Wiring

Basic Troubleshooting Techniques

- Branch / Control Circuit Problems and Troubleshooting
- Checking and Replacing Fuses

Electrical Maintenance Activities

- Performing Checks as Part of an Assured Equipment Grounding Program
- Use and Operation of GFCIs
- Types of Electrical Maintenance
- Special Precautions

Electrical Troubleshooting & Preventive Maintenance

CEUs: 1.6

Length: 2-Days

Course Description

Working with real world components, students in this “hands-on” electrical seminar will learn how to fix electrical problems plain and simple. This two-day Electrical Troubleshooting & Preventive Maintenance training was created to bring students up to speed in their electrical troubleshooting skills as quickly and safely as possible, and it was designed to cover the most commonly performed electrical troubleshooting tasks a maintenance technician faces in their job every day. For the novice or experienced electrician, this training course provides a no-nonsense, practical, and real world systematic approach to electrical troubleshooting. This course can also be adopted as part of a company’s regular Qualified Electrical Worker program.

Workshop Option

This course can be combined with our ‘Basic Electricity for the Non-Electrician’ for a complete 4-Day workshop.

Day 1 Discussion Topics:

Day One begins with a review of safety before moving to electrical drawings, meters, and troubleshooting basics. From there, students focus on troubleshooting components, circuits, and motors. We will also discuss proper PPE and why a proper fit is critical to working efficiently.

Basic Skills for Electrical Troubleshooting

- Safety First
- OSHA Requirements Regarding Troubleshooting and Qualified Persons
- Using Electrical Drawings – Hands-on Exercise
- Using Meters (multimeters) and Circuit Measurements
- Developing a Logical, Systematic Approach to Troubleshooting

Troubleshooting Control Circuits – Hands-on Exercise

- Relays, Motor Starters, and Control Devices
- Reading and Interpreting Ladder Diagrams
- Power Loss
- Control Circuit Industrial Applications
- Electric Motor Drives
- Solenoid-Operated Valves
- Heating Elements

Troubleshooting Motors

- Most Common Motor Problems
- Electrical Problems
- Testing Windings for Shorts, Opens and Ground Faults
- Phase Unbalance
- Mechanical Problems
- Phase Rotation Testing – Hands-on Exercise

Day 2 Discussion Topics:

Day Two introduces more complex electrical troubleshooting of power distribution systems, lighting circuits, VFDs, and PLCs. Finally, students discuss preventive maintenance to keep your equipment from failing in the first place.

Troubleshooting Power Distribution – Hands-on Exercise

- Wye and Delta Systems
- Overcurrent Protection
- Branch Circuits

Troubleshooting Power Quality Problems

- Sources of Power Quality Problems
- Test Equipment for Troubleshooting Power Quality Problems
- Harmonics

Troubleshooting Lighting Circuits

- Lighting Terminology
- Types of Lighting Circuits
- Incandescent Lighting
- Fluorescent Lighting
- HID Lighting

Troubleshooting Programmable Logic Controllers (PLCs)

- Overview of PLCs
- Reading PLC Ladder Diagrams
- Status Indicators and Error Codes
- Force and Disable
- Startup Procedures

Troubleshooting Variable Frequency Drives (VFDs)

- VFD Terminology
- VFD Basic Operation
- Components
- Pulse Width Modulation
- Types of VFDs
- Common Problems and Corrective Action

Electrical Preventive Maintenance

- Why Perform Electrical Maintenance
- Overview of an Electrical Maintenance Program
- Building Your Own Walk-Through Inspection Checklist

Advanced Electrical Troubleshooting

CEUs: .8

Length: 1-Day

Course Description

This single-day course is designed for electrical maintenance workers looking to gain additional in-depth hands-on understanding of complex control circuits. This course is intended to be taken only after completion of the Electrical Troubleshooting & Preventive Maintenance course.

Hands-on lab activities are the focus of this course. Throughout the day, participants will troubleshoot on a large variety of systems components, ranging from forward/reversing motor control circuits to proximity switches and float switches. Anyone who wants a chance to spend quality hands-on time and build expertise with components seen every day throughout their facilities will gain a great value from this course.

This optional 3rd day is only \$550 and helps take your troubleshooting skills to the next level.

Discussion Topics:

Advanced Skills for Electrical Troubleshooting

- Requirements per the National Electrical Code (NEC) for control circuits, and electric motors
- Overview of Motor rules per article 430 in the National Electrical Code
- Learn to navigate and troubleshoot from multiple page electrical drawings
- Using both NEMA and IEC Electrical Drawings for Troubleshooting
- Hands-on component troubleshooting using an electrical meter
- Learn advanced features of multimeters.
- Learning to ask the right questions and the correct way to approach troubleshooting

Testing Field Components: Hands-on Exercises

- Inductive proximity sensors
- Capacitive proximity sensors
- Magnetic proximity sensors
- Photoelectric sensor retroreflective/ visible red-light emission
- Float switches
- Control Relays
- Motor Starter Contactors
- Overload Devices
- Forward/Reversing motor starter
- Solid State Timers
- Limit Switches
- Auxiliary Contact Blocks
- Indicator Lamps
- Push Buttons
- Selector Switches
- 2-position
- 3-position
- Circuit Breakers

Build and Troubleshoot Advanced Motor Control Circuits – Hands-on Exercises

- Multiple Stop Start Stations
- Forward Reversing Circuits
- Level Control Circuits
- Test and understand all components
- Learn how to quickly troubleshoot
- Make field changes based on changes in the schematics
- Add remote control capabilities

Motor Troubleshooting and Preventative Maintenance

- Troubleshooting Single Phase and Three Phase Motors
- Troubleshooting DC Motors
- Important Motor Nameplate Parameters
- Preventive Maintenance for Motors
- Proper Tools for Motor Troubleshooting

The National Electrical Code® (NEC)

CEUs: 1.6

Length: 2-Days

Course Description

This NEC® training seminar teaches students how to navigate, use, and understand the NEC® as it applies to the electrical work they do. This seminar is frequently used by electricians for continuing education and licensing purposes. During this training seminar, our instructors will address the most recent changes to the code and answer questions related to students' specific work situations.

Day 1 Discussion Topics:

Day One begins with a review of safety before moving to electrical drawings, meters, and troubleshooting basics. From there, students focus on troubleshooting components, circuits, and motors. We will also discuss proper PPE and why a proper fit is critical to working efficiently.

Introduction to the National Electrical Code® (NEC)

- NEC® layout as the first step in successful navigation
- Differences between chapters 1-4 and 5-9
- How to quickly put yourself in the right chapter

Finding specific information in Chapter 1 General:

- Key words and definitions you must know
- Installation requirement topics

Finding specific information in Chapter 2 Wiring and Protection, on:

- Use and Identification of Grounded Conductors
- Branch Circuits
- Feeders
- Branch-Circuit, Feeder, and Service Calculations
- Outside Branch Circuits and Feeders
- Services
- Overcurrent Protection
- Grounding
- Transient Voltage Surge Suppressors

Finding specific information in Chapter 3 Wiring Methods and Materials, on:

- Wiring Methods
- Conductors for General Wiring
- Cabinets, Cutout Boxes, Meter Socket Enclosures Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and, Manholes Armored Cable
- Nonmetallic-Sheathed Cable: Types NM, NMC and NMS
- Flexible Metal Conduit: Type FMC
- Liquidtight Flexible Metal Conduit: Type LFMC: Rigid Nonmetallic Conduit: Type RNC
- Liquidtight Flexible Nonmetallic Conduit: Type LFNC: Electrical Nonmetallic Tubing: Type ENT
- Auxiliary Gutters
- Busways
- Cablebus
- Metal Wireways
- Surface Metal & Nonmetallic Raceways
- Cable Trays

Day 2 Discussion Topics:

Day Two introduces more complex electrical troubleshooting of power distribution systems, lighting circuits, VFDs, and PLCs. Finally, students discuss preventive maintenance to keep your equipment from failing in the first place.

Finding specific information in Chapter 4: Equipment for General Use, on:

- Flexible Cords and Cables
- Fixture Wires
- Switches
- Receptacles, Cord Connectors, and Attachment Caps Switchboards and Panelboards
- Luminaries, Lamp Holders, and Lamps
- Appliances
- Fixed Electric Space-Heating Equipment
- Motors, Motor Circuits, and Controllers, including Disconnecting Means for Motors
- Air Conditioning and Refrigeration Equipment
- Transformers and Transformer Vaults
- Equipment Over 600 Volts, Nominal

Finding specific information in Chapters 5 through 8, on:

- The interrelationships between the first four chapters and these chapters
- Special Occupancies
- Special Equipment
- Special Conditions
- Communication Systems

Finding specific answers from tables in Chapter 9

- How to Quickly Use Ready Information

Arc Flash Electrical Safety NFPA 70E®

CEUs: 1.6 – 2.4

Length: 2-3-Days

Course Description

The foremost goal of this Arc Flash electrical safety training seminar is to keep workers safe while working on or around electrically energized equipment. The seminar is structured to help companies fulfill requirements set forth in OSHA 29 CFR Part 1910, Subpart S Electrical and NFPA 70E® “Standard for Electrical Safety in the Workplace.” This Arc Flash electrical safety seminar is a must for any worker who spends time around electrically energized equipment. Overall, this program is designed to reduce liability concerns for the employer while establishing a culture of safe work practices among employees.

Day 1 Discussion Topics:

Day One begins with basic electrical safety and qualified electrical worker requirements. From there, the class will examine the hazards of electricity including the components specific to arc flash accompanied by how to identify and prevent possible accidents. Safe work practices are then covered including LOTO and proper PPE.

Electrical Safety & the Qualified Electrical Worker

- Background, Responsibilities, and Requirements
- Safety Standard Types: NFPA 70E® & Others
- OSHA Electrical Safety Regulations Overview
- Understanding Definitions

Electrical Hazards

- Power of Electricity
- Shock, Arc-Flash, and Arc-blast
- How to Identify Electrical Hazards
- Damage to People and Equipment
- Dangers of Static Electricity
- Accident Prevention
- Emergency Response

Safety Related Work Practices

- Work Related Definitions
- General Requirements
- Establishing Safe Work Conditions
- Electrical Lockout / Tagout
- Working On or Near Energized Parts
- Determining Proper Approach Distances
- Securing Energized Work Permits
- Understanding an Arc Flash Analysis
- Reading Arc Flash One Line Diagrams
- Personal Protective Equipment (PPE)

Day 2 Discussion Topics:

Day Two continues with discussions on the safety requirements for proper maintenance and for special equipment the focus moves to how employees can plan and implement an electrical safety program in their own facility that will comply with NFPA requirements. Finally, the class concludes by discussing some of the important changes the code cycle has undergone since the previous version in 2012.

Safety Related Maintenance Requirements

- Understanding General Requirements
- Common Electrical Equipment
- Premises Wiring
- Controller Equipment
- Fuses & Circuit Breakers
- Rotating Equipment
- Hazardous (Classified) Locations
- Batteries & Battery Rooms
- Portable Electrical Tools & Equipment (PPER)

Requirements for Special Equipment

- Electrolytic Cells
- Batteries & Battery Rooms
- Lasers
- Power Electronic Equipment

Electrical Safety Program

- Planning an Electrical Safety Program
- Implementation
- Complying with NFPA 70E®
- Interpreting Arc Flash Analysis Reports
- Determining your PPE Requirements
- Documentation of Records

Optional: Skills Improvement and ATMT® Certification

Students Perform the Following Tasks & Exercises

- Determine the minimum Hazard Risk Category for Specific Equipment
- Perform the 3 Point Testing Method
- Select the Appropriate Voltage Detector
- Review and Understand a Short Circuit Calculation Example
- Use Tables NFPA 70E® 130.7(C)(15)(a) and 130.7(C)(16) accurately
- Complete an Energized Work Permit
- Perform a Job Briefing
- Complete a Hazard Risk Assessment
- Complete a Blank Arc Flash Label
- Complete an Outside Contractor Agreement
- Determine the Limited, Restricted, and Prohibited Boundaries
- Review and take the ATMT® Electrical Safety Certification Exam

High Voltage Electrical Safety Training

CEUs: 1.6

Length: 2-Days

Course Description

The foremost purpose of this High Voltage Electrical Safety for Power GTD training seminar is to keep employees safe while working on or around high voltage power generation, transmission and distribution systems and equipment. In this seminar, students will learn how to work safely and efficiently around high voltage electricity. OSHA Requirement 29 CFR 1910.269 covers the operation and maintenance of electric power generation, control, transformation, transmission, and distribution lines and equipment. This seminar will outline all of the requirements in this OSHA ruling and how it applies to all electric power GTD operations. This High Voltage Electrical Safety Training seminar, while perfect for any student who works around electric power GTD installations, is specifically designed for personnel working on or around high voltage electrical lines equipment, or around substations, underground electrical installations, or power generators.

Day 1 Discussion Topics:

Day One reviews the relevant OSHA standard and examines electrical safety in the workplace. Students will learn the skills and techniques necessary to determine the nominal voltage of exposed live parts, the minimum approach distances corresponding to the voltages to which the qualified employee will be exposed, and the proper use of the special precautionary techniques, personal protective equipment (PPE), insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electric equipment.

- The OSHA Standard
- Electrical Current
- Electrical Shock, Arc, and Blast
- Understanding of Electrical Hazards
- Electrical Lockout/Tagout
- De-energized Equipment
- Electrical Safety Work Practices
- Energized Equipment & Circuits
- Personal Protective Equipment
- Enclosed Spaces
- Ladders & Platforms
- Excavations
- Hand & Power Tools
- Material Handling & Storage
- Inspection of Test Instruments
- Working on or Near Energized Equipment

Day 2 Discussion Topics:

Day Two focuses on workplace hazards and how to safely work around power lines. We take the practical knowledge gained in Day One and apply it to real world situations.

- Ground Fault Interrupters
- Ground Fault Protection Systems
- Clearance Distances for Installed
- Electrical Equipment
- De-energizing Lines
- Test and Test Facilities
- Overhead Lines
- Line Clearance
- Communication Facilities
- Maintenance of Electrical Equipment
- Grounding
- Underground Electrical Installations
- Power Generators
- Substations

Introduction to General Maintenance

CEUs: 1.6

Length: 2-Days

Course Description

This two-day course – offered for the first time and on a limited basis in 2018 – is designed to meet the essential needs of every maintenance technician in every type of facility. It is the first course of its kind to cover the fundamentals of electrical, HVAC, and mechanical maintenance tasks in a single two-day seminar, along with the basic safety skills that every worker needs.

This is an ideal starter course for new hires as well as experienced technicians who made need a refresher, and an excellent base for the more in-depth training we offer in our electrical, HVAC, and mechanical categories. Combine it with our new Troubleshooting Essentials for a 4-day workshop that will put your facility on a path to better safety and productivity..

Workshop Option

This course can be combined with our 'Troubleshooting Essentials' for a complete 4-Day workshop.

Discussion Topics:

Basic Safety Skills:

- Electrical
- Mechanical
- Lifting
- Chemical
- Ladder
- Fire
- Extinguishers
- Hand tools
-

Basic Electrical Skills:

- Electrical Safety in the workplace: 2018 NFPA 70E, OSHA
- When and how to select Personal Protective Equipment (PPE)
- Lockout/tagout (LOTO)
- Multimeter Selection and Safety
- Electricity Fundamentals (Voltage, Current, and Resistance)
- AC vs. DC and their Applications
- Single Phase vs. Three Phase

Basic Electrical Skills continued:

- Transformers and Electrical Distribution
- How to Select and Replace Switches and Receptacles
- When and Where should GFCI's be Used
- Replacing Light Fixtures/Ballast or Replace with LEDs
- Electric Motor Basics and Troubleshooting
- Fundamentals of Reading Electrical Schematics
- Preventative Maintenance Best Practices
-

Basic Mechanical and HVAC Skills:

- Mechanical Safety in the Workplace
- HVAC System Fundamentals and Inspections
- Common HVAC Preventative Maintenance Practices
- Boiler/Hot Water Heater Inspections
- Bearing Fundamentals, Types, and Applications
- Lubrication
- Belt Types, Alignment, and Tensioning
- Basics of Pumps, Blowers, and Fans
- Fire Extinguisher Use and Inspection

Wiring and Troubleshooting Residential Electrical Systems

CEUs: 1.6

Length: 2-Days

Course Description

This two-day hands-on seminar teaches students everything they wanted to know about wiring and troubleshooting residential electrical systems. This Wiring and Troubleshooting Residential Electrical Systems course was designed for anyone who works on apartment buildings, dormitories, hotels, or personal residences.

Day 1 Discussion Topics:

Understanding Residential Electrical Systems

- How electricity is supplied to residential systems
- The basics of voltage, current and resistance
- Distribution in residential system

Electrical Tools and Safety

- Hands-on exercises: Using meters, Using Voltage Detectors, and Measuring Values on Switches and Receptacles

Electrical Plans

- Practical Applications

Making Electrical Connections

- Hands-on Exercises: Using Pressure Connectors, Sizing and Using Twist-on Wire Connectors

Switches and Receptacles

- Hands-on Exercises: Wiring
 - Receptacles (115v, 15A and 20A; 220v for residential applications)
 - GFCI Wiring
 - Split-wire Receptacles
 - Lighting and Switches (single-pole, two-way, three and four-way), Switch-Loops

Day 2 Discussion Topics:

Working with Nonmetallic Sheathed Cable

- Hands-on Exercises

Creating Electrical Systems from Electrical Plans

Working with Metallic Sheathed Cable

Wiring with Conduit

- Typical conduit applications in residential work

Service Entrances

- Basic Requirements and Sizing

Remodeling, Wiring, and Troubleshooting Electrical Systems

Structured Wiring Systems Overview

PLCs for Non-Programmers

CEUs: 1.6

Length: 2-Days

Course Description

Using hands-on demonstrations in this PLC training, we convert the seemingly complex world of automation and Programmable Logic Controllers (PLCs) into practical, down-to-earth lessons the average non-programming person can understand. Students will learn to speak the PLC language, read and interpret PLC ladder logic, troubleshoot PLC systems and components, and fix the most common PLC problems on their own.

Workshop Option

This course can be combined with our 'PLC Programming & Applications' for a complete 4-Day workshop.

Day 1 Discussion Topics:

Day One of our PLC training focuses on understanding PLCs; how they work, terminology, and the hardware and software elements that make up a programmable logic controller. We will begin to examine the primary causes of faults associated with PLC based control systems: Input/Output devices and field wiring. You will learn to use both hardware and software to find these faults quickly. Students will learn a systematic approach to troubleshooting; how to set-up and configure local, remote, hierarchical and distributive control systems; how to configure Input/Output modules using various slot addressing techniques; how to understand program and data table file organization, number systems and processor information flow; and, how basic relay type instructions, timers and counters, and data manipulation instructions can be used to achieve the PLC solution you want. This focus during the PLC training will stretch into day two.

Speaking the Language of PLCs

- Hardware Focus
- How PLCs Work
 - Past
 - Present
 - Future
- PLC Terminology, PID
- Parts of a PLC
 - Input Interfaces
 - Processor
 - Output Interfaces
 - Power Supplies
 - Programming Terminals
- System Configurations
 - Local
 - Remote
 - Hierarchical
 - Distributive
- Hardware Considerations
 - Field Wiring
 - Master Control Relay
 - Isolation Transformers
 - Four Basic Types of Grounding

Day 2 Discussion Topics:

Day Two will continue to examine I/O and field wiring issues. We will also look at common troubleshooting techniques and strategies.

Reading PLC Ladder Logic

- Organization and Function of Ladder
- Logic Ladder Logic Data Table Organization
 - Numbering Systems
 - Data Table Files
 - Bit, Word and File Addressing
- Introduction to Programming
- Common PLC & PID Instructions
 - Basic Relay
 - Counters and Timers
 - Data Transfer
- Organization
 - Subroutine Files
 - Selectable Timed Interrupt (STI) Files
 - Jumps and MCR Instructions
 - Fault Routines
- Relating the PLC to "Real World" Applications

Troubleshooting PLC Systems & Components

- Safety
- Forcing of Input Data Table & Output Devices
- Identifying I/O Field Device Faults
- Identifying I/O Module Faults
- Identifying System Faults Using the Data Monitor Screen
- Using the Processor Status and I/O Status Screen

Find & Fix the 10 Most Common PLC Problems

- The "Ultimate PLC Troubleshooting Flowchart"
- Using Troubleshooting Tools
- Using Software Tools
- "Real World" Case Studies

PLC Programming & Applications

CEUs: 1.6

Length: 2-Days

Course Description

This two-day “hands-on” PLC Programming & Applications training program provides a greater depth of PLC knowledge for those who have already taken TPC Training’s introductory course PLCs for Non-Programmers, or have a similar background and experience working with PLCs. It is designed to help maintenance technicians, electricians, and others modify and write common PLC programs on their own. It will provide students the comfort and confidence they need to edit or create new PLC solutions for their specific work applications. It will make vendor-specific PLC programming manuals understandable.

Workshop Option

This course can be combined with our ‘PLCs for Non-Programmers’ for a complete 4-Day workshop.

Day 1 Discussion Topics:

Day one starts with a quick review of PLC basics before moving on to an introduction of the laptops and simulation software the students will be using to learn PLC programming. Depending on the students’ needs and applications to be discussed in your specific class, the instructor may use RsLogix, Direct Soft 5 and/or LogixPro™ 500 simulator programs. The similarities and differences between relay ladder logic and PLC ladder logic are covered next. Then the students begin to write common control programs that demonstrate simple circuit design concepts (like series, parallel, holding, and latching), and then test their programs on a simulator.

PLC Quick Review

- PLC Block Diagram and Major Components
- Inputs and Outputs and Sequence of Operation
- Types of PLCs and Associated Software
- Numbering Systems
- PLC Basic Instructions

Design and Program Selected Exercises Using Logixpro-500 Simulator

- Introductory Exercise: Relay Logic
- Applying Relay Logic: Door Simulation
- Applying Relay Logic to a Process: Silo Simulator
- Introductory Exercise: PLC Timers
- Applying Cascading TON Timers: Traffic Control
- Introductory Exercise: Word Compare
- Applying Word Compare Instructions: Traffic Control
- Introductory Exercise: PLC Counters
- Applying PLC Counter Instructions: Batch Mixing
- Dual Compressor Exercise: Sharing the Workload
- Advanced Batch Mixing Exercise: Your choice of instructions
- Applying Bit Shift Instructions: Bottle Line Simulation
- Multi Floor Elevator Control: Which Way to Go?
- Interfacing to 7-Segment Displays: Includes Bottle Line Wiring Details

Day 2 Discussion Topics:

Day two moves into more complex programming commands such as timers, counters, and compare functions that students will write and test again. Following these lessons, the student will take a relay ladder logic circuit and convert it to PLC logic and write the program for that circuit using the software of their choice. Students will now use the cumulative knowledge presented in this class to create programs that are even slightly more complex. These exercises include silo sim, traffic light sim, batch sim, bottle and line sim.

Additional Programming Applications

- Student Exercises: DirectSoft
- Discussion of commonly used PLCs and Programming Applications

Function Block Diagram (FBD) and Programming Exercises

- Function Block Diagrams Overview: Advantages and Usage
- FBD Construction
- Understanding Structured Text and FBDs
- Student Exercise: Write FBD Programs Advanced Concepts
- Scripting
- Mnemonic Programming Code
- Smart Relays
- Pico Controller

Advanced Concepts

- Scripting
- Mnemonic Programming Code
- Smart Relays
- Pico Controller

Variable Frequency Drives

CEUs: 1.6

Length: 2-Days

Course Description

This hands on seminar introduces the student to the world of variable frequency drives. This seminar will be most helpful to workers in industrial plants and commercial buildings. Students will learn how to improve VFD control and efficiency, troubleshoot and fix VFDs, reduce equipment downtime, eliminate chronic VFD problems, lower the cost of VFD operation, and alleviate the need for hiring costly outside service contractors, all while establishing a culture of safe work practices among employees.

Workshop Option

This course can be combined with our 'Variable Frequency Drive Advanced Applications' for a complete 4-Day workshop.

Day 1 Discussion Topics:

Day One of the Variable Frequency Drive training focuses on the background and basics of using VFDs, where and how they are used in the workplace. The class discusses how VFDs can improve efficiency, safety and cost savings and discusses the various types of VFDs.

VFD Safety Review

- Electrical Hazards
- LOTO (Lockout – Tagout)
- Personal Protective Equipment & Insulated Tools

Electrical Basics Review

- Multimeter, Clamp-On, Megohmmeter
- Single Phase and Three Phase Motors
- Motor Troubleshooting and Replacement
- Basic Control Circuits & Troubleshooting

What VFDs Do

- Motion Control / Motor Speed
- Air Flow / Liquid Flow / Pressure Control
- Eliminates the Need for Variable Transmission or Sheave, Variable Vanes or Dampers on Fans, Variable Valves on Pumps

Benefits of Using a VFD

- Energy Savings
- Easier Maintenance
- Enhanced System Monitoring

Load Types

- Constant Torque – Conveyors, Positive Displacement Pumps, Superchargers
- Variable Torque – Centrifugal Fans, Pumps, Saws, Routers, Planers

VFD Options

- Bypass – Two- or Three-Contactor Style, Disconnect Switch Style, Soft Starter
- Fusing – VFD or Bypass Protection
- Input / Output Reactors
- Motor Overload Device
- Transient Protection
- Auxiliary Relays
- Power Line Phase Reversal Detection

Day 2 Discussion Topics:

Day Two of the Variable Frequency Drive training begins by examining setup and programming to get optimal performance out of your VFD. We end by reviewing maintenance and troubleshooting so that you can keep your equipment up and running.

Installation of a VFD

- Environmental Concerns, Clearances, and Conduit Entry

Customer Connections

- Safety Circuit
- Start / Stop / Jog
- Status and Fault Indication
- Remote Speed Reference
- Monitoring of Motor Parameters

Wiring & Grounding VFDs

- Induced Signals
- Inductive, Capacitive
- Incoming Power (line), Motor (load), and Control Wiring
- Proper Grounding Methods

Controlling a VFD

- Keypad and Terminal Strip Control
- Bus Communication, Open Loop and Closed Loop Control
- Manual and Automatic Operation
- Sensorless Flux Vector
- PI Loop Configuration
- Sensor or Transducer Feedback and Motor Shaft Encoder Feedback

VFD Setup, Programming, and Troubleshooting

- Language, Display, and Control Modes
- Open and Closed Loops
- Motor Data
- Power (kW), RPM, Voltage, and FLA Current
- Service and Power Factors
- Motor Speeds and Ramp Times
- Start-up, Switching, and Skip Frequencies
- Limits for Alarms or Faults
- Inputs / Outputs – Analog, Digital, and Relay
- Application Functions
- No Load
- Phase Loss
- Anti Windup
- Integral Time / Differential Time
- Proportional Gain / Differential Gain
- Lowpass Filter

Variable Frequency Drive Advanced Applications

CEUs: 1.6

Length: 2-Days

Course Description

This seminar is invaluable for technicians needing to know about drives in an industrial and process control environment. We will explore power quality in your facility, remote drive control, advanced communication between multiple drives, compensating for slip, the negative impact on the general duty motor, boosting torque, and how to determine when to skip frequency. After attending this seminar, your VFD skills will be greatly enhanced and will help minimize downtime in your workplace.

Workshop Option

This course can be combined with our 'Variable Frequency Drives' for a complete 4-Day workshop.

Day 1 Discussion Topics:

Electrical Basics Review

- Personal Protective Equipment and Insulated Tools
- Electrical Hazards and Safe Approach Distances
- LOTO (Lockout – Tagout)
- Meters: Multimeter, Clamp-On, Megohmmeter
- Motor and Control Circuit Basics and Troubleshooting

What VFDs Do

- Benefits of Using a VFD
- Motion Control / Motor Speed
- Air and Liquid Flow / Pressure Control

Load Types

- Constant Torque and Variable Torque

VFD Options

- Bypass – 2-3 Contactor Style, Disconnect Switch Style, Soft Starter
- Fusing – VFD or Bypass Protection
- Input / Output Reactors
- Motor Overload Device
- Transient Protection
- Auxiliary Relays
- Power Line Phase Reversal Detection

Installation of a VFD

- Environmental Concerns
- Clearances
- Conduit Entry

Customer Connections

- Safety Circuit, Start / Stop, and Jog Circuits
- Status and Fault Indication
- Remote Speed Reference
- Monitoring of Motor Parameters

Wiring & Grounding VFDs

- Induced Signals
- Inductive, Capacitive
- Incoming Power (line), Motor, and Control Wiring
- Proper Grounding Methods

Controlling a VFD

- Keypad Controls
- Terminal Strip Control – Automatic, Manual
- Bus Communication Control
- Open and Closed Loop Control
- Manual and Automatic Operation
- Sensorless Flux Vector
- PI Loop Configuration
- Sensor or Transducer and Motor Shaft Encoder Feedback

Day 2 Discussion Topics:

VFD Setup, Programming, and Troubleshooting

- Language, Display, and Control Modes
- Open Loop, Closed Loop
- Motor Power (kW), RPM, Voltage, and FLA Current
- Service and Power Factors
- Speed References and Limits
- Motor Speeds and Ramp Times
- Skip, Switching, and Start-up Frequencies
- Limits for Alarms or Faults
- Inputs / Outputs – Analog, Digital, and Relay
- Application and Closed Loop Functions
- Proportional Gain / Differential Gain
- Lowpass Filter

The Electrical Hazards associated with VFDs

- Osha and NFPA 70E® Regulations
- Electrical Hazard and Risk Assessment
- Importance of LOTO (Lockout – Tagout)
- Proper Personal Protective Equipment and Approach Distance

Using Closed Loop Control to Improve Torque

How Encoder Feedback Provides Wider Ranges of Control

- More Process Variables and Improved Speed Regulation
- Ability to Run at a Higher Reference Frequency
- High-Speed Control without High Dynamic Responses

Controlling Multiple Motors from One VFD

- Sizing the Drive for Total Current
- Implementing External Motor Overload Protection
- Correct Sizing of Conductors, Contactors and Overloads

Types of Transducers for Different Applications

- Pulse Type (Digital Encoder)
- Voltage Feedback (0-5, 0-10VDC)
- Current Loop 4-20 ma
- 3-15 Pressure Transducer

How Power Quality is Impacted by the VFD

- Harmonics in Your Facility
- Voltage Regulation
- EMI Filtering
- Solutions to Mitigate Power Quality Issues

One Source to Control Multiple VFDs

Using Documentation of Parameters to Solve Advanced Problems

Using Preventive Maintenance to Extend the Life of Your Drive

Electrical Ladder Drawings, Schematics and Diagrams

CEUs: 1.6

Length: 2-Days

Course Description

In the field of equipment maintenance, installation or modification, the ability to read and understand electrical ladder drawings, schematics and diagrams is an absolute must. Several types of drawings and diagrams will be examined during this electrical course, including Block, Pictorial, One-line, Wiring, Terminal, and Schematic. The differences between these drawings will be emphasized and the purpose and flow of each type will be clarified. Electrical Ladder Drawings, Schematics and Diagrams training will include exercises where students create schematic diagrams based on circuit descriptions, as well as interpreting schematic drawings so that they can provide verbal or written circuit descriptions.

Day 1 Discussion Topics:

Electrical Fundamentals for Print Reading

- Clarifying Terminology
- Effects of Current Flow
- Voltage Drop Calculations
- Understanding Ampacity Tables
- Importance of Electrical Drawings
- NEC® Drawing Requirements
- Drawing Control

Electrical Drawing Basics

- Types and Uses of Electrical Drawings
- Drawing Preparation and Ownership
- Design / Bid / Build Process
- Written Specifications

Electrical Drawings for Building Maintenance & Construction

- Component Symbols
 - Wiring & Connections
 - Power Source
 - Breakers
 - Disconnects
 - Fuses
 - Fuse Block
 - Contactors
 - Overloads
 - Loads
 - Grounds
 - Others
- Electrical Drawings
 - Site or Plot Plan
 - Elevation
 - Section
 - Detail
 - Power Riser
 - One-Line Diagram
 - Electrical Floor Plan
 - Lighting Plan
 - Schedules
 - Feeder and Lighting Schedules
 - Panelboard Schedules
 - Motor & Equipment Schedules
 - Wiring Diagrams
- Reading & Interpreting Code Requirements
- Real World Applications

Day 2 Discussion Topics:

Industrial Control Prints

- Component Symbols
 - Transformers
 - Fuses
 - Jumpers
 - Switches
 - Relays
 - Timers
 - Transducers
 - Sensors
 - Circuit Loads
 - Grounds
 - Circuit Commons
 - Others
- Understanding Relay Operation
- Electrical Schematic Diagrams
- Motor Termination Diagrams
- Electrical Ladder Diagrams for Control Circuits
- Block Diagrams
- IEC Symbols
- NEMA and IEC Circuit Comparison
- Reading & Interpreting Basic Motor Control Circuits
- Forward-Reverse Motor control

Real-World Applications

- Conveyors
- Air Compressors
- HVAC Controls
- Burner Combustion
- Extruder DC Drive Motor (VSD)
- Process Temperature Controls
- Exterior Lighting Controls
- Generator Controls
- Chemical Process Controls
- Others

PLC Ladder Diagrams

- PLC Basics – Inputs & Outputs
- Comparison of Relay Logic to PLC Ladder Logic
- Real-World Applications

Cross-Referencing International & European Symbols

Electric Motors and Motor Control Circuits Repair & Maintenance

CEUs: 1.6

Length: 2-Days

Course Description

Electric motors tend to fail regularly and replacing them is commonplace. But did you know that it doesn't have to be that way? While motor failure may appear to be a common problem, it is more likely that the real enemy is a wrong application or control circuit issue. Failure of the motor can be just a symptom of perhaps an even more serious problem that lies ahead. This electrical course on Electric Motors and Motor Control Circuits helps maintenance workers identify what the real issue is when a motor burns out and how to prevent it from happening again.

Day 1 Discussion Topics:

Day One of the motor repair course focuses on basics such as motor selection, maintenance, safety, troubleshooting, and procedures for replacing a motor.

Motor Selection, Maintenance, Testing, and Replacement

- Motor Basics and Terminology
- Types of Motors and their Suitable Applications
- Testing Equipment
- Field Troubleshooting Checklist
- Motor Selection
- Nameplate Data
- IEC Motor Ratings
- Energy Considerations

Safety Issues When Troubleshooting or Replacing Motors

- Hazards of Rotating Equipment
- OSHA Lockout / Tagout Requirements
- Determining Power Supplies and Voltages
- Verifying Circuits De-Energized – Safely and Correctly!
- Personal Protective Equipment (PPE) Requirements
- Visual Inspections

Procedures for Replacing A Motor

- De-Terminating Motors
- Setting Replacement Motors
- Shaft Coupling / Alignment Options
- Electrical Checks
- Sizing Line Conductors
- Using Nameplate Data for Proper Connections
- Selecting the Best Method of Motor Termination
- Lugs and Insulation Tapes for Termination
- Termination Kits
- Methods of Verifying Proper Phase Rotation
- Lubrication Requirements
- Sizing Fuses and Overloads
- Final Checks Prior to Re-Energizing Motor
- Electrical, Visual, and Mechanical Checks for Startup Testing

Motor Maintenance

- Motor Windings and Megohmmeter Testing
- Modern, State-Of-The-Art Predictive Maintenance Testing for Motors
- Bearings and Lubrication
- Motor Storage
- Determining Voltage and Current Imbalance and Its Effects
- Recommended Maintenance Practices of NFPA 70B
- Sizing and Adjusting Overloads per the NEC®
- Common Motor Problems and How to Find and Fix Them

Day 2 Discussion Topics:

Day Two builds on the fundamentals learned in the first day. This day is all about control circuits, fundamentals, types, and special applications.

Working with Control Circuits

- Fundamentals of Control Circuits
- Types of Motor Control
- Symbols for Control
- Learn to Read Motor Control Schematic and Ladder Diagrams
- Watch Motor Control Circuits Operate On-Screen Before the Class
- Learn the Basics of PLC Ladder Logic
- Watch Plc Ladder Diagrams Operate On-Screen Before the Class
- Developing a Logical, Systematic Approach to Troubleshooting Controls
- Typical Control Circuit Problems and How to Find and Fix Them

Motor Drives and Special Control Circuit Applications

- Energy Management and Motor Drives
- AC and DC Drives Overview
- Motors for Variable Speed Drives
- Variable Speed Drive Applications
- HVAC Applications
- Servo Motors and Drives for Manufacturing
- Review Operation of Modern Automation Control Such as Pick and Place and Conveyor Drives

Instrumentation, Process Measurement & Control

CEUs: 1.6**Length:** 2-Days

Course Description

Proper troubleshooting and maintenance of plant systems & equipment to reduce downtime and save money requires more than just replacing parts when they get broken. In fact, a “replace-part-when-broken” strategy for maintaining equipment is frequently the most expensive approach you can take. To be effective, maintenance technicians who fix equipment must know why a part needs to be changed out in the first place. In this instrumentation, process measurement, and control seminar students will learn what, where, and how to measure parameters for the proper monitoring and control of their equipment. When something breaks, they’ll now know why. With this understanding, they will be able to work much more efficiently on the industrial systems and processes for which they are responsible. A sound knowledge in instrumentation and control is certain to result in better-qualified technicians and fewer equipment failures.

Day 1 Discussion Topics:

Introduction To Process Control

- On / Off
- Proportional
- Integral
- Derivative

Pneumatic Control

- Operation of The Nozzle and Flapper Value
- Bellows Receiver Unit

Electronic Control

- Resistance
- Capacitance
- Inductance
- Voltage

Measurement of “Pressure”

- Units and Pressure Standards
- Construction and Operation of Typical Industrial Pressure Instruments
- Calibration of Pressure Transducers and Transmitters

Measurement of “Level”

- Units and Level Standards
- Construction and Operation of Typical Industrial Level Instruments
- Calibration of Level Transducers and Transmitters

Measurement of “Flow”

- Units and Flow Standards
- Construction and Operation of Typical Industrial Flow Instruments
- Calibration of Flow Transducers and Transmitters

Measurement of “Temperature”

- Units and Temperature Standards
- Construction and Operation of Typical Industrial Temperature Instruments
- Calibration of Temperature Transducers and Transmitters

Day 2 Discussion Topics:

Selected Analytical Measurements

- Electrical Conductivity
- Chemistry 101
- Acids
- Bases
- pH
- Redox Potentials
- ORP Measurement
- Ion Activity Measurement

Industrial Process Control Symbols

- Understanding ANSI / ISA-S5.1 Process Control Symbols
- Understanding and Drawing Process and Instrumentation Diagrams
- Understanding and Drawing Instrument Loop Diagrams
- Using Process Control Diagrams To Troubleshoot Industrial Control Systems

Control Valves

- Purpose and Use of Control Valves, Actuators, and Positioners
- Significance of Valve Coefficients and Sizing Considerations

Proportional Control Concepts

- First Order Lag Calculations
- How To Calculate Dead Time
- Adding Manual Reset To Proportional Control
- Case Studies

Proportional and Integral Control Concepts

- Additional Process Dynamics
- The Dynamic Behavior of Control Valves
- Tuning PI Controllers
- Case Studies

Pid Controllers

- Open Loop Tuning Methods
- Closed Loop Tuning Methods
- Case Studies
- Common Industrial Applications, and Case Studies
- Applications For Use In Your Own Facility

DC Electrical Systems for Mobile Vehicles & Equipment

CEUs: 1.6

Length: 2-Days

Course Description

DC electrical systems are more common and more complex all over the world and TPC Training now offers a 2-Day seminar that focuses solely on that. Students will learn safety, identifying electrical problems, troubleshooting, using the correct tools, wiring diagrams, and more. Students will come out of this training seminar with a deep understanding of DC systems in mobile vehicles and equipment.

Day 1 Discussion Topics:

Day One starts with the fundamentals of DC systems. Students learn the background of DC electricity including components. They'll move on to wiring and diagrams to get a better understanding of circuit design and current flow.

History and Evolution

- 6V
- 12V
- 24V
- 36V
- Theory
- AC & DC Electricity
- Creating & Storing Electricity
- Current Flow
- Ohm's Law
- Electricity & Magnetism

Components

- Batteries
- Conductors & Insulators
- Control Devices
- Circuit Protection Devices
- Generators & Alternators
- DC Motors
- Semiconductors
- Microprocessors

Wiring Diagrams & Schematics

- Symbols
- Layout
- Component State & Function
- Understanding Circuit Design
- Understanding Current Flow
- Locating Conflicts

Day 2 Discussion Topics:

Day two is all about troubleshooting: How to spot problems, assess them, and repair them.

Troubleshooting Tools & Equipment

- Basic Tools
- Meters
- Scopes
- Scanners
- Charts and References
- Internet and Other Resources

Troubleshooting Process

- Have a Systematic Approach
- Using the Service Manual
- Locating Components
- Understanding Illustrations and Drawings
- Determining Equipment to Use
- Testing Components
- Wave forms
- Tricks & Other Methods

Troubleshooting Case Studies and Exercises

- Where to Start
- Theory of Operation
- Using the Diagrams
- Choosing the Equipment
- Testing
- Understanding the Results of the Test
- Making Decisions

Verifying the Fix

ControlLogix™: Fundamentals, Communications, Applications and Troubleshooting

CEUs: 1.6

Length: 2-Days

Course Description

In the field of equipment maintenance, installation, or modification, the ability to understand and work confidently on programmable logic controllers is a must. This course is designed to introduce technicians to the AB ControlLogix™ system architecture and the software that controls it.

Understanding the basic hardware associated with a system including input modules and output modules and how they are configured is a key component to being able to troubleshoot a PLC controlled machine. Beyond the hardware side you will learn how to communicate with the ControlLogix™ system and how to upload and download projects with a complete understanding of the different CPU modes.

Day 1 Discussion Topics:

This seminar is all about ControlLogix™ and Day One starts with a system overview, terminology, definitions, hardware and communications.

ControlLogix™ System Fundamentals

- Introduction to ControlLogix™
- ControlLogix™ Architecture
- System Overview
- Project Organization
- Operator Interfaces

Communications

- RSLinx
- Configuring Ethernet Modules
- Communication Networks
- Network Addressing
- CPU Modes
- Uploading Projects
- Downloading Projects

ControlLogix™ Hardware

- Input Modules
- Output Modules
- CPU
- Communication Modules
- Digital vs. Analog
- Remote I/O

Day 2 Discussion Topics:

Day Two emphasizes more complex ControlLogix™ functions such as ladder logic, I/O addressing, editing programs, and troubleshooting.

Program Management

- Numbering Systems
- ControlLogix™ I/O
- Addressing Relay Type Instructions
- Ladder Logic Basics
- Timers
- Counters
- Comparison Instructions
- Creating and Monitoring Tags
- Rung Documentation
- Configuring I/O

Troubleshooting

- Documentation
- Proper Troubleshooting Technique
- Searching and Cross Reference
- Status Light Indicators
- Input / Output Troubleshooting
- Safely Working with Forces
- Software Resources and Applications

Generators & Emergency Power

CEUs: 1.6

Length: 2-Days

Course Description

This 2-Day Generators & Emergency Power training seminar will focus on Generators & Emergency Power so that students will be prepared if there is an emergency situation. This electrical training course provides practical, real world knowledge to keep your facility running smoothly in all situations because regardless of the cause, lack of electricity at your facility can have disastrous consequences. During this seminar, you will learn what you can do, and should do, to make sure your facility will keep running even if the electricity to your facility doesn't.

Day 1 Discussion Topics:

Day One introduces the basics of generators and prime movers including different types, electrical fundamentals, and typical systems.

Generators and Prime Movers

- Overview: Generator Purpose, Operation, and Control
- Types of Prime Movers
- Generator Basic Electrical Fundamentals
- Generator Types and Construction
- Grounding and Bonding of Generator Systems
- UPS System Fundamentals

Protection and Transfer of Electrical Power

- Circuit Breakers
- Switchgear
- Transfer Switches
- Parallel Operation

Generator and Engine Controls

- Governors
- Voltage Regulators
- Engine Protection for Generators
- Onsite Generator Controls including PLCs and SCADA Systems

Auxiliary Systems

- Fuel Systems
- Cooling Systems
- Exhaust Systems
- Vibration Attenuation
- Sound Attenuation
- Engine Starting Systems
- Load Banks
- Emissions Control

Day 2 Discussion Topics:

Day Two moves into general applications and focuses on troubleshooting and basic maintenance.

Generator Applications

- Cogeneration
- Emergency Power Systems
- Legally Required Standby Systems
- Optional Standby Systems

Troubleshooting and Maintenance of Onsite Power Generation Systems

- Developing a Logical Systematic Approach to Troubleshooting Generators
- Common Generator Problems
- Recommended Generator Maintenance Practices
- Electrical Testing of Generator

Uninterruptible Power Supply (UPS) Systems

CEUs: 1.6

Length: 2-Days

Course Description

How often do you get a chance to work with the Uninterruptible Power Supply system in your facility? Do you know what steps to take in the event of an emergency so that your facility can be kept up and running? What is your procedure if something goes wrong? What about regular testing and preventive maintenance? This two day Uninterruptible Power Supply (UPS) Systems training seminar is perfect for anyone who could be at a facility when a power outage occurs – the plant electrician, maintenance technician, or a supervising engineer, for example. Backup emergency systems are essential, but only valuable if you have the people on staff trained to work with them in emergency situations. This Uninterruptible Power Supply (UPS) Systems seminar is designed to make sure your plant and facility personnel are ready for anything.

Day 1 Discussion Topics:

Why Have a Uninterruptible Power Supply System (UPS)

- Types and Duration of UPS
- Power System Disturbances
 - Sags
 - Surges and Spikes
 - Outages
 - Phase relationships
- The CBEMA Curve

Three General Types of UPS

- Kinetic (Motor Generator Sets)
- Flywheel
- Static
 - Rectifier
 - Batteries
 - Inverter

Three Types of Static UPS

- The Traditional UPS
- The Static UPS
- The Static UPS with Bypass

Review of Passive Electronic Components

- Volts, Ohms, and Amps in DC and AC Circuits
- Resistors
- Capacitors
 - Formed Caps
 - Failure Mode of Electrolytic Capacitors
- Inductors
 - Coils and Chokes
 - Single Phase Transformers
 - Three Phase Transformers
 - Wye
 - Delta
- RLC Circuits in Series and Parallel
 - Tuned Circuits
 - Harmonics
- Ferro Resonance

Day 2 Discussion Topics:

How Batteries Work

- Primary and Secondary Batteries
- Lead Acid
 - The Chemistry
 - Battery Types, Safety, and Maintenance
 - Capacity Factors
 - S-Curves
 - Float and Equalize Voltages
 - Load Testing
- Nickel Cadmium
 - The Chemistry
 - Battery Types
 - Capacity Factors
 - Float and Equalize Voltages
 - Load Testing

Review and Troubleshooting of Active Components

- Diodes
 - Half-Wave and Full-Wave Rectification
 - Polyphase and Wye/Delta Rectification
- Transistors
- Thyristors
 - SCRs
- TRIACS
- IGBTs
 - Triggering Circuits
- Operational Amplifiers
 - Instrumentation Amplifier
 - Inverting Amplifier
 - Non-Inverting Amplifier
 - Ramping Applications

UPS Topologies

- Single Phase
- Rectifiers
- Inverters

Three Phase

- Rectifiers
- Inverters

Troubleshooting & Maintenance

Manufacturer's Recommended Maintenance Practices

- Installation and Electrical Safety
- Quarterly and Annual Checklists
- Tools and Equipment

Photovoltaic Solar Power Fundamentals & Maintenance

CEUs: 1.6

Length: 2-Days

Course Description

If you are interested in learning more about the world's fastest growing form of power generation, solar power, this seminar is for you.

In today's environment, nothing can be taken for granted. With the ever-changing landscape of power generation, the need for renewable energy has never been greater. Be on the front edge of this ever-growing need and learn how solar energy can make a positive impact at home or at work by attending this Photovoltaic Solar Power Fundamentals & Maintenance seminar. This training will introduce you to the solar industry and its many applications. You will learn the fundamentals of solar energy and photovoltaics, system sizing and configuration, as well as system maintenance and troubleshooting. If you are new to the solar industry or need to learn to maintain an existing system, this seminar is for you.

Day 1 Discussion Topics:

Day One of this exciting 2-Day Photovoltaic Solar Power Fundamentals & Maintenance seminar emphasizes electrical basics to make sure our students have a strong foundation in electrical properties. We'll examine electrical fundamentals before moving on to the basics of solar power and solar power systems.

Electrical Fundamentals

- AC vs. DC
- Basic Electrical Circuit
- DC String Circuit Layout
- Series vs. Parallel
- Batteries
- PV Modules

Photovoltaic Basics

- PV Markets and Applications
- History to Future
- Safety Considerations
- PV System Payback and Expected Life Cycle
- PV Certifications

Photovoltaic System Components

- DC Modules
- AC Modules
- Combiner Boxes
- Inverters
- Charge Controllers
- Batteries
- Racking
- Mounting Hardware

Day 2 Discussion Topics:

Day Two is all about solar power systems; how to build them, how to maintain them, and how to troubleshoot any potential problems.

Photovoltaic System Design

- Sight Evaluation and Test Conditions
- System Types
 - Stand Alone
 - Grid Type
 - Hybrid
- PV System Sizing Principles
- PV System Configurations
- Installation Requirements
- Battery Systems
- Inverter Type Systems

Photovoltaic System Commissioning

- Review Drawings/Blueprints
- System Startup
- Proper Tools
- Site Conditions and System Efficiency
- NEC Requirements for PV Systems

Photovoltaic System Maintenance and Troubleshooting

- General Maintenance Procedures
- System Monitoring
- Troubleshooting PV System Components
- Logical Troubleshooting Approach
- Common Problems

Pump Repair & Maintenance

CEUs: 1.6

Length: 2-Days

Course Description

The title of this seminar says it all – this Pump Repair & Maintenance training seminar helps students understand what to do when a pump stops working and how to repair it. Broken pumps can have drastic consequences at your facility. Overall, this training program is designed to teach technicians how to bring pumps back to life when they fail, what they should learn from those failures, and then what to do to make sure they never happen again.

Day 1 Discussion Topics:

This pumps training seminar starts on Day One with the fundamentals of pump design including the types of pumps and their parts.

Centrifugal Pump Design

- A Short History
- Bernoulli's Principle and the Venturi Effect
- Centrifugal Pump Design

Pump Parts and Identification

- Wetted End Parts
- Dry End Part
- Pump Tree
- Drivers

Bearing Removal and Installation

- Bearing Types and Life
- Proper Installation of Pump Bearings
- Press Fitting
- Thermal Installation
- Lubrication of Pump Bearings

Bearing Failure Analysis

- Disassembling a Bearing for Inspection
- Troubleshooting Bearing Failures

Simple Vibration Measurement

- How to Read a Vibration Meter
- Measurement of Vibration Velocity
- Troubleshooting Using a Vibration Meter

Acoustical Measurement of Pump Bearing Condition

- Creation of a Pothole Index
- Spalling and How to Determine When It Occurs
- Pump Bearings Condition Guide

Split Case Pump Rebuilding Techniques

Pump Foundations

- Anchoring, Shimming, and Grouting

Pump Shafting Inspection and Repair

- Shaft Condition & Drawings
- Stub Shaft Techniques
- Bowed Shafts
- Diameter Corrections

Day 2 Discussion Topics:

In Day Two, we go even deeper into the world of pump repair by tackling even more complex pump repair issues.

Pump Case Repair

- Spray Metalizing
- Epoxy, MIG, and TIG Repair

Suction and Discharge

- End Suction Pump Rebuilding Techniques

Pump Coupling and Shaft Alignment

- Soft Foot Inspection and Correction
- Shaft Alignment Techniques
- Taper Gauge and Caliper

V-Belt Drives for Pumps

- Types of Belts
- Sheave Groove and Belt Inspection
- Force Deflection Method of Belt Tensioning

Dynamic Balancing

- When is Balancing Required and How is Balancing Done?
- Effects of Balancing on Bearing and Seal Life

Wetted End Pump Troubleshooting

- Cavitation
- Unbalance of Impellers
- Volute Wear
- Piping Strain
- Air Entrainment
- Seal Failure
- Flange Leaks

Packing

- Types of Shaft Packing
- How to Pack and Repack a Pump

Mechanical Seals

- Types of Mechanical Seals
- Seal Installation and Troubleshooting

Bolted Sealing Values for Wet End Assembly

- Sequence Diagrams and Torque Charts

Developing a PM Program for Pumps

- Check Sheets
- Pressure Testing
- Dead Heading
- Vibration Measurement
- Flow Testing
- Pump Purchases & Acceptance

Pumps & Pump Systems: Specification, Installation, & Operation

CEUs: 1.6**Length:** 2-Days

Course Description

Better than learning how to replace or repair a pump, wouldn't it be more efficient and a greater cost savings if you just knew how to prevent a pump from failing in the first place? This pumps and pump systems training seminar emphasizes centrifugal pumps and the systems that run them quickly and efficiently. It includes discussions on basic pump design, function and application, and was specifically created for anyone who is responsible for pump specification, installation, and operating efficiency at their facility.

Day 1 Discussion Topics:

Day One starts by making sure students understand basic pump functions and features so that they can learn how to properly specify a pump. Students move on to how to select the right pump, then proper system design, and pump installation.

Pump Classification

- Positive Displacement Pumps
- Dynamic Pumps

Basic Hydraulic & Pump Concepts & Definitions

- Defining Pressure
- Head
- Specific Gravity
- Why Head Instead of Pressure?

How Centrifugal Pumps Work

- How Centrifugal Pumps Induce Flow

Net Positive Suction Head (NPSH)

- NPSHR vs. NPSHA
- Pump Cavitation
- NPSH Margin

Horsepower & Efficiency

- Losses
- Calculating Efficiency
- Effects of Viscosity

Reading Pump Curves

- Single Line Curves
- Multiple Trim Curves
- Multiple Speed Curves
- Affinity Laws

Pump System Curves

- Calculating System Heads
- Where the Pump Will Operate
- Changes in the System Curve
- Determining a Pump's Operating Point

Day 2 Discussion Topics:

Effect of Pump Operation on Mechanical Reliability

- Axial & Radial Loads
- Shaft Deflection
- Seal & Bearing Life
- Start Up and Commissioning Procedures
- Minimum Flow Restrictions

Specifying the Right Pump

- Matching the Right Pump for the Job

Bearings

- Lubrication Methods
- Failure Modes
- Proper Maintenance
- Proper Lubricant Care

Seals & Packing for Pumps

- Types of Packing
- Proper Packing Installation
- Correctly Adjusting Packing
- Mechanical Seals
- Pusher & Non Pusher Designs
- Single Seals
- Double and Tandem Seals
- Dry Gas Seals
- Other Sealing Methods

Good Pump System Design & Installation Practices

- Building Reliability from the Foundation Up
- Alignment
- Types of Misalignment
- Alignment Methods

Optimizing Your Pump Operation

- Pump Energy Efficiency
- Improved Reliability
- Better Process Control
- Effect of Pump Speed on Pump Life

Pump Troubleshooting

- Common Pump Problems and their Solutions
- Root Cause Analysis

Condition Monitoring of Pumps

- Vibration and Lubricant Analysis
- Alternative Methods

Steam Systems Maintenance, Safety, & Optimization

CEUs: 1.6

Length: 2-Days

Course Description

Steam Systems are not only one of the biggest consumers of energy in most plants or facilities, but they can also be hazardous to work on or around if proper care is not taken. This 2-Day seminar on steam systems maintenance will teach you how to keep your steam system working efficiently and how to fix common problems and work safely. Emphasis is given so that a maintenance technician can quickly identify and solve common problems in steam systems and take corrective actions to reduce energy loss.

Day 1 Discussion Topics:

Day One begins with fundamentals of boilers, pipes, condensate systems, and steam valves. On this day, we build the framework for the rest of the seminar.

Steam Fundamentals

- Boiler & Combustion Process
- Thermodynamics
- Reading Steam Tables
- Steam Distribution and Utilization

Piping & Fittings

- Piping Materials and Construction
- Pipe Sizing
- Pipe Lagging
- Steam Fittings
- Expansion Joints
- Guides and Anchors
- Support and Labeling Requirements
- Seismic Restraint Requirements

Piping Insulation

- Energy Loss
- Material Selection
- Sizing
- Asbestos Insulation
- Best Practices for Removal of Insulation

Condensate Systems

- Condensate Removal
- Condensate System Designs, and Operation
- Condensate Return Management
- Condensate System Testing and Maintenance

Steam Valve Maintenance

- Types – Manual Control, Pilot Control, & Automatic Operation
- Leakage
- Valve Testing – the Safe Way
- Valve Maintenance – Packing, Lapping, & Adjustments

Safety Relief Valves

- Types
- Codes
- Setting
- Testing
- Maintenance & Adjustments

Day 2 Discussion Topics:

Day Two emphasizes maintenance and troubleshooting. We will also discuss ways keep your steam system running efficiently.

Steam Leaks

- Checking for Steam Leaks – Safely
- Managing Steam Leaks & Maintaining System Operability

Steam System Management & Maintenance

- Steam Effects on Mechanical Components
- Cutting
- Corrosion
- Thermal & Mechanical Shock
- Steam System Troubleshooting
- Best Practices in Steam System Management

Water Management in Steam Systems

- Water Quality and Steam
- Water Hammer, Causes, Effects, and Prevention

Steam Traps

- Design and Operation
- Sizing and Selection
- Testing
- Repair

Steam Pressure and Temperature Control

- Pressure and Temperature with Steam
- Pressure Reduction
- Temperature Control
- Pneumatic Rotary Control
- Steam Isolation Valves

Steam System Energy Management

- Cost of Steam
- Heat Exchanger Efficiency
- Combustion Efficiency
- Efficiency Tests
- Flash Recovery Systems

Plumbing & Pipefitting for Plants & Buildings

CEUs: 1.6

Length: 2-Days

Course Description

Regardless of what type of plant or facility you operate in, plumbing and piping systems are critical to keeping your building and equipment up and running at all times. When pipes or plumbing are inoperable, it not only can affect the way an entire facility operates, but it may even shut parts of it down. TPC Training's Plumbing & Pipefitting for Plants & Buildings training seminar provides in-house technicians and engineers the skills they need to keep plumbing and piping systems functioning at all times and how to recognize and repair common problems found in commercial buildings without relying on outside contractors.

Day 1 Discussion Topics:

We start with the basics on Day One of the Plumbing & Pipefitting seminar. We will discuss fundamentals of pipes; schematic drawings, codes, sizes, fittings, joints, and insulation. One this day we lay the groundwork for the second day of training.

Introduction

- Plumbing and Pipefitting Terms and Definitions
- Materials and Tools
- Safety Principles

Reading Plumbing and Pipefitting Drawings

- Drawings and Detail Sheets
- Piping System Color Code Identification

Codes and Regulations

- Finding and Following Plumbing Codes
- Sewer Requirements
- Prohibited Fittings and Practices
- Protection of Piping and Structures
- Seismic Restraint Requirements

Piping and Piping Systems

- Piping Materials and Construction
- Pipe Sizing
- Pipe Lagging
- Fittings
- Expansion Joints
- Guides and Anchors
- Support and Labeling Requirements
- Excavation and Underground Systems

Plumbing Joints and Fittings

- Types of Joints and Fittings
- Wiped
- Solvent Cement Plastic Pipe
- Flanged Fixture Connections
- Soldered Joints

Piping Insulation

- Energy Loss
- Material Selection
- Sizing
- Best Practices for Removing and Installing Insulation

Day 2 Discussion Topics:

Now that the foundation of pipe systems is in place, Day Two focuses on maintenance and troubleshooting.

Testing Piping Systems and Equipment

- Pretests
- Service Flow, Head Pressure, Hydrostatic, and Steam Blow Tests
- Drainage Lines

Valve Maintenance

- Types - Manual Control, Pilot Control, and Automatic Operation
- Valve Storage and Handling
- Leakage
- Valve Testing and Maintenance – Packing, Lapping, and Adjustments
- Gasket and Washer Maintenance

Hot Taps

- Hot Tap Safety
- Repairing and Replacing Hot Tap Fittings

Plumbing Fixtures and Appliances

- Strainers and Strainer Maintenance
- Overflows – Connections
- Wall-Hung Fixtures: Sinks, Toilets, and Water Fountains
- Floor Drains
- Shower and Emergency Wash Stalls
- Prohibited Fixtures

Sanitary and Storm Drainage Systems

- ABS, PVC, Cast Iron, and Other Materials
- Assigning Fixture Units to Plumbing Fixtures
- Sizing Drainage Lines and Venting the Piping Systems

Traps

- Trap Seals, Floor Drain, and Prohibited Traps

Cleanouts

- Sizing and Location of Cleanouts
- Cleanout Maintenance

Water Distribution Systems

- Municipal Services
- Pressure
- Backflow-prevention
- Flushometer Valves
- Water Pressure Regulation
- Water Hammer
- Water Conservation Equipment
- Potable Water Supply and Distribution
- Water Quality Problems and Solutions

Plumbing and Pipefitting Maintenance Program

Understanding & Troubleshooting Hydraulics

CEUs: 1.6

Length: 2-Days

Course Description

Being able to operate, maintain, and troubleshoot your own hydraulic equipment and systems starts with simply understanding how and why all the various components work. This hydraulic repair and troubleshooting seminar provides the basic building blocks and knowledge needed to be proficient working with industrial hydraulics and fluid power.

Day 1 Discussion Topics:

Day one of this hydraulic repair and troubleshooting course focuses on examining what hydraulic systems are and how they work. Students will start with an overview of hydraulic principles and progresses through hydraulic system components including pumps, valves, cylinders, motors, rotary actuators, accumulators, and filters with emphasis placed on component structure and the identification of the components by the proper symbol as standardized by ANSI and ISO. Topics include:

- Hydraulic Principles
- Positive-Displacement Pumps
- Flow Control Valves
- Directional Control Valves
- Check Valves
- Hydraulic Cylinders
- Hydraulic Motors
- Hydraulic Rotary Actuators
- Pressure Control Valves
- Pilot Operated Pressure Control Valves
- Accumulators
- Fluid Conductors
- Reservoirs, Heat Exchangers, and Filters

Day 2 Discussion Topics:

Day two builds on the knowledge gained on Day One to include troubleshooting of your hydraulic system. We know that it is critical to avoid downtime in your facility and our students will use this day to focus on maintaining an efficient system and doing it safely.

- Application of Hydraulics
- Troubleshooting
- Hydraulic Safety
- Basic Troubleshooting Requirements
- Generalization on Hydraulic Troubleshooting
- Noisy and Cavitating Pumps
- No System Pressure
- Low or Erratic System Pressure
- No Movement of Actuator
- Slow or Erratic Actuator
- System Running Hot
- Common Cylinder Problems
- Solenoid Failure
- Internal and External Leaking Control
- Troubleshooting Hydrostatic Transmission

Troubleshooting Mechanical Drive Systems & Rotating Equipment

CEUs: 1.6

Length: 2-Days

Course Description

It is no secret that downtime is expensive. Regardless of the precautions you've taken and preventive maintenance practices you've implemented, sometimes things just go wrong and you need it fixed now. But in order to fix it you must know how to isolate and define the problem, and that's what this course is all about – teaching you how to quickly and accurately troubleshoot mechanical drives and rotating equipment so that you can avoid costly downtime.

In this 2-Day seminar, we'll provide the student a new perspective on troubleshooting mechanical drives and rotating equipment. Rather than teaching about "equipment specific" situations we'll take a more novel approach. We'll teach you to troubleshoot based on the common components that make up a piece of specified equipment so that you can go back to the workplace and troubleshoot just about anything regardless of its function, design, or manufacturer. No matter what type of equipment you may confront on the job, after attending this seminar you will have the tools and skills to properly troubleshoot just about any problem you may encounter.

Day 1 Discussion Topics:

Day One focuses on understanding machine components and failure mechanisms.

Overview of Rotating Equipment

- What is Common to All Types of Equipment?

The Maintenance Educational Component (MEC)

- Definition, Application, and Understanding How Equipment Works

Bearings

- Anti-Friction and Plain

Measurement of Critical Components

- What to Measure and How to Measure

Shafting

- Types of Shafts
- Uses and Applications
- Repair and Maintenance

Housing

- Types of Housing
- Re-machining and Repairs

Lubrication

- Importance of Lubrication and Types of Lubrication
- What Needs to be Lubricated and How and When to Lubricate

Shaft Couplings

- Errors of Omission
- Maintenance

V-Belts

- Failure Modes

Chain Drives

- "Pitching" a Solution

Positive Drive Belts

- Reducing Tension Headaches

Gears and Gearing

- Removing the Mystery
- Repair and Maintenance

Day 2 Discussion Topics:

Day Two emphasizes troubleshooting faults and applying corrective action.

Vibration Analysis

- Simple Measurement Practices
- Using Data for Troubleshooting

Fast Fault Finding

- Vibration as Your Tool

Acoustical Troubleshooting

- Using Sound as a Tool
- What to Listen for

Infra-red Inspection

- Methods and Devices
- When to Use it
- What Your Readings Mean

Oil Analysis

- Hidden Problems Revealed
- Analyzing Your Oil
- Corrective Action

Motors

- Using the Nameplate for Information
- Sizing the Motor to the Job

Megger Testing

Troubleshooting Trees

- Types, Uses, and How They Work

Basic Troubleshooting

- Best Practices
- Minimum Changes to get Maximum Results

Pumps, Blowers, and Fans

- The Most Common Problems
- Looking for the Obvious
- Noise and Capacity Changes

Maintenance Welding

CEUs: 1.6

Length: 2-Days

Course Description

This Maintenance Welding seminar includes discussions on welding skills improvement and is specifically designed for welding technicians and other personnel working in industrial plants, construction, manufacturing, metalworking and fabrication shops, and other similar facilities or applications. This seminar will focus on welding principles before spending the majority of the time on welding on various types of metal. As always, safety is a big part of our seminar curriculum. Overall, this maintenance training program is designed to teach students how to produce smooth, strong, quality welds while establishing a culture of safe work practices among employees.

Day 1 Discussion Topics:

Fundamentals and basics come first in this maintenance welding seminar. Day One explores techniques, principles, concepts, metallurgy, and welding symbols and drawings. We will get into the heart of this seminar discussing welding on various types of metal: steel, alloys, stainless steel, and cast iron.

Techniques in Welding

- Butt and Lap Joint
- Fillet
- Complete and Partial Joint Penetration
- Welding Positions

Types of Welding Processes

- STICK (SMAW)
- MIG (GMAW)
- TIG (GTAW)
- Other: Flux Cored (FCAW) and Oxy-Acetylene

How to Weld on Steel

- Steel and Its Alloys
- Selection of Welding Processes
- Preheating
- Best Practices for Welding on Steel

How to Weld on Aluminum Alloys

- Selection of Welding Processes
- Filler Metals for Aluminum Alloys
- Best Practices for Welding on Aluminum Alloys

How to Weld on Stainless Steel

- Types of Stainless Steel
- Filler Metal Selection for Stainless Steel
- Best Practices for Welding on Stainless Steel

How to Weld Repair Cast Iron

- Problems in Welding
- Filler Metal Selection
- Best Practices for Welding Cast Iron

Day 2 Discussion Topics:

Day Two builds on the concepts learned on day one. We will continue discussions on welding on different types of metal focusing on copper and copper alloys. We will examine the cutting process before studying perhaps the most important aspect of all – safety.

Welding and Brazing on Copper and Copper Alloys

- Welding and Brazing on Cast and Wrought Products
- Filler Metal Selection
- Best Practices for Welding on Copper and Alloys

Review of Cutting Processes for Maintenance Welding

- Plasma Machines
- Oxy-Acetylene

Welding Safety

- Heat Protection
- Electrical Shock
- Radiation Protection
- Hearing Protection
- Smoke and Fume Protection

Welding Costs and Records

- Use of Welding Codes
- Personnel Certification
- Written Welding Procedures
- Welding Costs Direct and Hidden

Maintenance Management Basics for First-Line Supervisors

CEUs: 3.2

Length: 4-Days

Course Description

This comprehensive 4-Day seminar is designed to help maintenance managers and supervisors transform their workplace with maintenance planning, predictive maintenance, and total productive maintenance techniques. Students will learn how to achieve dramatic cost reduction through improved resource utilization and reduced downtime. Students will complete the course with a firm foundation for both implementing these practices and building a solid business case for investments in maintenance planning toolsets.

Day 1 Discussion Topics:

- The Objective and History of TPM
- ROI: A Profit Contribution Through TPM
- The Concept of Critical Equipment
- Applying 5S Methodology
- Repair Cost Analysis
- TPM Tool Kit
- Applying Overall Equipment Effectiveness
- Visual Controls for Process Effectiveness
- The Cost of Equipment Downtime

Day 2 Discussion Topics:

- The Objective of Planning and Scheduling
- Elements of the Planning and Scheduling Process
- Time Motion Analysis and the Leverage of Planning
- In-House Tasking Contractors
- OSHA: the Changing Face of Safety and Compliance
- Improving Repair Parts Inventory Controls and Costs
- The Maintenance-Operations Planning Meeting

Day 3 Discussion Topics:

- Work Order Prioritization and Completion
- Key Performance Indicators (KPIs)
- The Role of CMMS
- Applying Mobile Technology
- The Proper Role of Maintenance

Day 4 Discussion Topics:

- Predictive Maintenance Methodology
- Financial Benefits of Preventive vs. Reactive Maintenance
- Lifecycle Cost Analysis
- Comparing Maintenance Strategies
- Demonstrating the Cost of Repeat Failures
- FMEA Basics
- Seal Failure Analysis Programming
- Opportunities Shown by the P-F Curve
- PdM Tools: Vibration, Oil, Infrared, and Ultra-Sound Analysis
- PdM Application Matrix
- Reporting Metrics Improvement
- The Evolution to Reliability Centered Maintenance (RCM)
- Predictive Maintenance Energy Savings

Inventory Control for Maintenance

CEUs: 1.6

Length: 2-Days

Course Description

Inventory Control for Maintenance means having the right product and materials when you need it and where you need it. Having too much material, not enough material or having to search for the material leads to higher costs and can mean longer downtimes, not to mention the frustration!

This 2-Day plant management seminar focuses on building an inventory management system that will lead to better control through optimization of inventory quantities, organization of inventory, and access to inventory. Having the right data and implementing procedural controls for your inventory will help maximize the value of every dollar spent on maintenance and reduce the time it takes to have the right part on hand when you need it.

Day 1 Discussion Topics:

Day One of this 2-Day seminar starts with an overview of inventory management. We'll discuss basic concepts and best practices before diving into storeroom specifics.

Overview of Maintenance Inventory Management

- Role of Maintenance in Organizations
- Importance and Impacts of Maintenance Inventory Management
- How Inventory Impacts Profits
- How Inventory Impacts Uptime / Downtime
- Methods and Concepts of Inventory Management

World Class Inventory Management

- World Class Management Defined
- How Do You Compare to World Class?
- Understanding World Class Management
- Common Problems in Inventory Management

Inventory Management Team Concepts

- Roles and Responsibilities in Inventory Management
- Building an "Inventory Team" throughout the Organization
- Committees
- Setting Goals
- Measuring Success
- Rewards
- Problem Solving
- Building an "Inventory Team" with Vendors
- What is a Good Vendor?
- What Can a Vendor Do for Me?
- Selling the Vendor Your Program
- Maximizing Your Vendor's Value
- Working with Management on the Program
- Accountability and Ownership

Storeroom Requirements

- Environmental / Climate Control
- Receiving Doors and Locations
- Documentation of Movement of Inventory
- Housekeeping and Keeping Storerooms Clean

Storeroom Layouts

- Physical Layout – ABC Analysis
- Ideal Locations for Parts
- Bins, Drawers, or Carousels
- Item Location Systems
- Security Systems
- Stopping the Open Door Inventory Dilemma
- Storeroom Process and Procedures

Day 2 Discussion Topics:

Day two continues by discussing security and procedures. Finally, we will discuss computerized systems, implementing storeroom changes and decision making.

Storeroom Security

- Types, Levels, and Options
- Why You Need a Secure Environment
- Who is Part of the Security Team?

Storeroom Procedures

- Primary ID
- Stores Stock Catalog
- Part Descriptions
- Getting Information on Every Potential Item
- Store Stock Numbering
- Identification of All Parts & Materials
- Order Quantity EOQ
- Order Point – Lead Time Usage, Safety Stock
- Stock Index for ID
- Inventory Classification
- Location Codes
- Stock Number or Bin Location
- Bill of Materials (BOMs)
- Consignment Inventory
- Inventory Accuracy – Cyclical Count
- Planning and Inventory Control
- Insurance Items
- Parts vs Kits vs Materials
- Optimization of Inventory
- Pre-Picking / Pre-Staging

Storeroom Contents

- What and How Much Do You Need?
- Open Stock vs. Free Issue
- Controlling Additions and Deletions

Working with a CMMS (Computerized Maintenance Management System)

- Bar Coding and Micro-Chip Technology
- Connecting with your CMMS

Metrics & Decision Making Tools

- Practical Measurements and Accounting Systems
- Measuring Inventory Turns
- Minimum / Maximum Levels
- Service Levels
- Analysis of Storeroom Measures Procedure
- Measuring Vendors

Implementing a World Class Storeroom

Maintenance Planning and Scheduling

CEUs: 1.6

Length: 2-Days

Course Description

We know that one of the worst things for any facility is equipment downtime. In an ever increasingly competitive marketplace, the maintenance department is routinely asked to keep equipment running longer, with fewer failures and at lower costs. The maintenance planning and scheduling functions are critical components to make any maintenance program run with the new expectations. This 2-Day training course provides the fundamentals of maintenance planning and scheduling required for any successful maintenance program.

Day 1 Discussion Topics:

The Maintenance Process Overview

Planning Maintenance Time

A Look at World Class Companies, Principles, and Metrics

A Look at Other Industries

Maintenance Work Process Flow

The Planning Process

- Work Approval Process and Validation
- Effective Validation
- Categorizing Work Requests
- Developing Criteria
- Work Request Approval

Work Order Detail

- The Walk Down Process

Day 2 Discussion Topics:

Creating a Detailed Job Plan

- Gathering Required Information
- Downtime Requirements & Details
- Contractor or Outside Service Requirements

Maintenance Scheduling

- The Scheduling Process Overview
- Pre-Meeting Organization
 - Planned Work Order Listing
 - Detailed Job Plans for High Priority Work Orders
 - Contractor Requirements Shutdown Requirements
 - Current Production Schedule
- Prioritization
- The Scheduling Meeting
 - How to Schedule
 - Priorities
 - Equipment Availability
 - Labor Utilization
 - Final Schedule Creation
 - Use of Timelines

Maintenance Metrics

Continuous Improvement Techniques and Methods

Predictive Maintenance and Condition Monitoring

CEUs: 1.6

Length: 2-Days

Course Description

With ever increasing demands from top management to do more work and decrease costs, investing in predictive maintenance and condition monitoring makes more sense today than ever. While many organizations still rely heavily on time based maintenance, it's a proven fact that condition monitoring maintenance requires less personnel and saves money and downtime.

This course provides the fundamentals of PdM and condition monitoring applicable to plants, facilities, and manufacturing lines. Predictive Maintenance & Condition Monitoring will provide students with a framework to make the right decisions on what equipment needs condition monitoring, what technologies to use to meet their needs, and how to measure the effectiveness of their decisions.

Day 1 Discussion Topics:

Predictive Maintenance Program Types

- Break down
- Preventive
- Predictive

Failure Rate vs. Time

- Bath tub Curve
- Definition: Weibull Distribution Curve of Failure Rate vs. Time

Sixteen PdM Program Benefits

- How to Develop a PdM Program Worksheet with Microsoft Excel

Four Foundations for Improving Reliability

- Developing and Fostering the Culture of Reliability
- Product Mission
- Reliability Specifications
- Defining Universal Failures

Comparing Maintenance Strategies Based on Cost and Availability

- Run to Failure
- Scheduled Repair/Replacement
- On-Condition Inspections

Basic Concepts of FMEA (Failure Modes and Effects Analysis) and FMECA (Failure Modes and Effects with Cause Analysis)

Techniques for Identifying Probability and Costs of Equipment Failure

- Recovering CMMS Data
- FMEA Data – Failure Modes and Effects Analysis
- IEEE 493 Standards of Electric Motors

Using Maintenance Log Data

- Times-to-Failure, Suspension Time, and Times-to-Repair
- MTBF – Mean Time Between Failures

Root Cause Analysis for Beginners

- What Happened? How? Why?
- How to Do Cause Charting for Root Causes Possible Causes
- Implementation Action Steps

How to Sell Root Cause Analysis to Management

- Preserving Evaluation Data
- Building the Analysis Team and Analyzing the Data
- Communication of Findings and Recommendations
- Tracking Cost Savings
- Calculating Bottom Line Results
- Case History: How to Set Up a Seal Failure Analysis Program
- Four Step Process

The Role of Reliability Centered Maintenance

Day 2 Discussion Topics:

PdM for Manufacturing Plant Operators

The Relationship Between Availability and Reliability

- Relationship Chart
- Profit Benefits of Operational Availability
- How to Calculate Up-time Value in Profit Dollars

Down-Time Analysis

- F.R.E.D. Reporting – Failure, Evaluation, and Display Reporting

A Review of PdM Technologies – Four Hour Presentation

- Bearing Failure Analysis with Case History
- Vibration Analysis
- Preventive
- Predictive

How PdM Technologies Integrate with RCM-Reliability Centered Maintenance

How to Write a PdM Return On Investment Report

- Interactive Exercise – 1.5 hours

On-Line Monitoring for Instant Machine Condition Diagnostics

- Monitoring Machine Conditions
- How to Make Recommendations for Repair

The Future of Predictive Maintenance

Miscellaneous: How to Use Conformance Testing for Contractor Suppliers

- Case History by Predictive Maintenance Services Inc.

Total Productive Maintenance (TPM) & 5S™

CEUs: 1.6

Length: 2-Days

Course Description

Total Productive Maintenance (TPM) focuses on getting managers, maintenance personnel, and equipment users all working together to prevent equipment problems and reduce expenditures. By giving ownership and responsibility of equipment and processes to the right employees, equipment breakdowns are reduced. 5S provides a systematic approach to setting standards and visual guides for preventing breakdowns and making your equipment run smoothly.

Day 1 Discussion Topics:

The first step in reducing breakdowns, stoppages, and lowering costs is understanding how and why equipment fails. This is the focus of Day One as we start to causes and types of equipment failure and learn to use root cause identification tools.

Workplace Organization Using 5S

- Sort
- Set in Order
- Shine
- Standardize
- Sustain

Five Tools to Ferret Out Root Causes

Types of Equipment Failures

Causes of Equipment Failure

Day 2 Discussion Topics:

Day Two looks at building an effective maintenance team, measuring overall equipment effectiveness, and implementing 5S. Students will be ready to implement total productive maintenance in their own facilities.

Creating a Maintenance Team

- Operator Involvement Maintenance
- Personnel Involvement
- Management Involvement
- When and How to Report Problems

Cleaning and Inspecting

Continuous Improvement of Equipment

- Measuring Overall Equipment Effectiveness (OEE)
- How Measurement Develops Proper Focus for Maintenance
- Six Big Losses Resulting from Inadequate Maintenance
- Calculating OEE

Key Elements of Preventive Maintenance

Tracking Preventive Maintenance

Building Effective Checklists

Key Elements of Predictive Maintenance

Team Work

- Operator's Role
- Maintainer's Role
- Management's Role

How Visual Controls Assist Total Productive Maintenance

Communicating the TPM Mentality to Everyone in the Facility