Maintenance Tech Classes - Level 1

Total hours for certification	244.00
Average hours per week	2.35
Window of availability	2 years

	Hours	Weekly Hrs
Curriculum 1	140.5	2.70
Curriculum 2	103.5	1.99

Fundamentals

Class #	Topic	Curriculum	Hours To Complete
101	Reading Blueprints	1	9
102	Reading Schematics	1	9
104	Making Measurements	1	9
107	Hand Tools	1	9
108	Power Tools	1	9
109.1	Health and Safety	1	9
110	Trouble Shooting Skills	1	9

Electrical

Class #	Topic	Curriculum	Hours To Complete
201	Basic Electronics and Electricity	2	9
204.1	Electrical Measurement Tools	2	9
205.1	Electrical Safety and Protection	2	9
207	Single Phase Motors	2	9
210	Electrical Troubleshooting	2	9

Mechanical Systems

Class #	Topic	Curriculum	Hours To Complete
301	Basic Mechanics	1	9
302	Lubricants and Lubrication	1	9
304	Bearings	1	9
305	Pumps	1	9
307	Basic Hydraulics	1	9
309	Basic Pneumatics	1	9

Electronics

Class #	Topic	Curriculum	Hours To Complete

Energy Conservation

Class #	Topic	Curriculum	Hours To Complete

Industrial Hazard Control

Class #	Topic	Curriculum	Hours To Complete
151	Chemical Hazards	1	3

Machine Shop Practices

Class #	Topic	Curriculum	Hours To Complete
315	Machine Shop Pratices	1	8.5

Machine Tools

Class #	Topic	Curriculum	Hours To Complete
162	Basic Handtools	1	9
163	Work Planning and Setup	1	3

Material Handling

Class #	Topic	Curriculum	Hours To Complete
331	Bulk Material Handling	2	5

Power Plant Operations			
Class #	Topic	Curriculum	Hours To Complete
111	How Power Plant Works	2	4.5

Process Controls			
Class #	Topic	Curriculum	Hours To Complete
271	Intro to Process Control	2	5.5
273	Pressure Measurement	2	5.5
274	Force, Weight and Motion	2	5.5
275	Flow Measurement	2	10
276	Level Measurement	2	5
277	Temperature Measurement	2	5

Programmable Logic Controllers			
Class #	Topic	Curriculum	Hours To Complete
298	PLC Controllers	2	7

Water and Waste Water			
Class #	Topic	Curriculum	Hours To Complete
383	Maintaining Waste Water Equip	2	5.5

Rigging Equipment			
Class #	Topic	Curriculum	Hours To Complete

Mechanical Mtnc Applications			
Class #	Topic	Curriculum	Hours To Complete

Reading Blueprints

Course 101: Reading Blueprints

Covers all types of blueprints used in industrial plants. Discusses machine parts and machine drawings. Features drawings of a compound rest and a clutch-brake control. Examines hydraulic, pneumatic, piping, plumbing, electrical, air-conditioning, and refrigeration drawings. Introduces sketching used in industrial plants. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Introduction to Blueprints

Topics

Importance of Blueprints; Purpose of Blueprints; Types of Information on Blueprints; Supplementary Spaces; Detail Drawings; Interpreting a Detail Drawing; Assembly Drawings; Orthographic Projections; Auxiliary Views; Sections; Pictorial Drawings

Objectives

- Identify details, markings, and machine parts from an assembly drawing.
- Identify an object from an orthographic drawing.
- Identify elements located within the title block of a detail drawing.
- Explain why more than one orthographic projection is needed to show an object on a blueprint.

Lesson 2: Machine Parts

Topics

Six Simple Machines; Screw Threads; Drawings of Screw Threads; Screw Thread Specifications; Heads; Rivets; Welds; Pins; Keys; Springs; Gears; Bearings; Belts and Pulleys

Objectives

- Describe what a machine is, and explain what it does.
- Name the two basic methods of joining machine parts.
- Name and identify from an exhibit several types of threaded fasteners.
- Name the two basic methods of permanent joining.
- Identify gears, bearings, and belt drives on drawings.
- Identify types of screw threads from a specification.

Lesson 3: Machine Drawings

Topics

Understanding Machine Tools; Purpose of the Compound Rest; Exploded View; Assembly Drawing; Detail Drawing; Comparison with Photograph; Clutch-Brake Control Mechanism; Exploded View; Assembly Drawing; Headstock Linkage; Clutch-Operating System; Assembly Drawing; Drafting Techniques for Gear Trains; Reading the Assembly Drawing

Objectives

- Name the main parts of a lathe.
- State the definition of an exploded view.
- Identify an assembly drawing.
- Identify a compound rest swivel on an assembly drawing.
- Identify a specific part on an assembly drawing.

Lesson 4: Sheet Metal Drawings

Topics

Sheet Metal; Ventilation Systems; Ductwork; Sheet Metal Drawings; Parallel Development; Miter Development; Radial Development; Extra Metal for Assembly

Objectives

- Describe the difference among coils, strips, and sheet metal.
- Describe how a ventilation system works.
- State the purpose of an arrow on a duct symbol.
- Demonstrate how to lay out a development.
- Define a radial development of a truncated pyramid.

Lesson 5: Building Drawings

Topics

Using Building Drawings; Buildings and Building Sites; Symbols and Conventions; Plat, Site Floor Plans; Working Drawings

Objectives

- Name building materials, given their standard symbols.
- Explain how to find useful information on a flow diagram.
- Explain how to find useful information on an industrial plat.
- List the contents of a set of building drawings.
- Describe the purpose of a structural drawing.

Lesson 6: Hydraulic and Pneumatic Drawings

Topics

Fluid Systems; Pascal's Law; Multiplying Forces; Pistons and Cylinders; Fluid System Components; Hydraulic and Pneumatic Symbol

Objectives

- Name the components represented by common symbols on hydraulic and pneumatic drawings.
- Name the components in a simple hydraulic power system.
- Name the components in a simple pneumatic power system.
- State Pascal's Law.
- Discuss the purposes of the components of hydraulic systems.

Lesson 7: Piping and Plumbing Drawings

Topics

Importance of Piping Systems; Piping and Plumbing Materials; Kinds of Joints; Fittings; Drawings; Joining Metal Pipes

Objectives

- State the definition of piping.
- Explain why joints are sometimes brazed instead of soldered.
- Explain how to assemble a screwed joint.
- Identify different types of pipe joints.
- Identify piping-system components shown in a single-line drawing.
- Define electrochemical corrosion.

Reading Blueprints

Lesson 8: Electrical Drawings

Topics

Importance of Electrical Drawings; Electric Power; Controlling Electricity; Electrical Drawings; Electrical Wiring; Using Electrical Drawings

Objectives

- Identify different electrical symbols on a drawing.
- Identify the power distribution panels in your plant.
- Identify different types of conduit and cable.
- Select the best electrical drawing to use when looking for a faulty circuit between the basement and the first floor.
- Explain how electricity at 480 volts is reduced by a transformer to 120/240 volts.
- Define the terms voltage, current, and power

Lesson 9: Air Conditioning and Refrigeration Drawings

Topics

Principles of Refrigeration; Component Drawings; Principles of Air Conditioning; Air-Conditioning Systems; A/C and R Operating Controls; A/C and R Drawings

Objectives

- Explain how a refrigeration system works.
- Describe the types of ac controls.
- Name three kinds of condensers used in air conditioning systems.
- Explain the difference between unitary and central air-conditioning equipment.
- Explain how to find useful information on a duct drawing.

Lesson 10: Sketching

Topics

Using Sketches; Making Sketches; Kinds of Sketches; Orthographic Sketches; Isometric Sketches; Perspective Sketches

Objectives

- Name the four kinds of sketches.
- Identify an isometric sketch.
- Describe the appearance of a perspective drawing.
- Discuss how to sketch straight lines and curved lines.
- State the definition of a vanishing point.

Reading Schematics and Symbols

Course 102: Reading Schematics and Symbols

Covers schematics and symbols used in commercial and industrial settings. Examines symbols on schematics, electrical symbols and diagrams, piping symbols and diagrams, hydraulic and pneumatic diagrams and symbols. Discusses air conditioning and refrigeration systems, including explanations of electrical/electronic control schematics. Covers welding and joining symbols. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Introduction to Schematics and Symbols

Topics

Symbols in Schematics; Using Schematics; Electrical Schematics; Pneumatic and Hydraulic Schematics; Piping Schematics; Value of Schematics; Looking for Flow; Electric Current; Fluid Flow

Objectives

- State the definition of a schematic.
- List some characteristics of schematics.
- Identify a schematic among other kinds of technical drawings and diagrams.
- Explain how flow is indicated on a schematic.

Lesson 2: Symbols on Schematics

Topics

Common Features of Schematics; Differences in Schematics; Using the Schematic; Understanding Symbols; Identifying Symbols; Identifying Connections; Reading Diagrams

Objectives

- Identify various types of lines on schematics
- Identify the following schematics by their symbols:
  - Electrical
  - Fluid-power
  - Piping
- Give the purpose of legends and other tables of symbols.

Lesson 3: Electrical Symbols

Topics

Wires and Connections; Switches; Power Supply; Electrical Loads; Coils and Transformers; Fuses and Circuit Breakers; Grounding; Contacts; Resistors; Symbols in a Diagram

Objectives

- State the meaning of symbols and lines on an electrical schematic.
- Explain the difference between a fuse and a circuit breaker.
- Explain how to trace an electrical circuit.

Lesson 4: Electrical Diagrams

Topics

Kinds of Electrical Drawings; Schematic Diagrams; Series and Parallel Circuits; Wiring Diagrams; Reading Electrical Diagrams; Reading Industrial Schematics; Practice Exercises

Objectives

- Explain the difference in current flow between a series circuit and a parallel circuit.
- Explain the purpose of a wiring diagram.
- Demonstrate how to read an electrical schematic.
- Identify the objects represented by the symbols on an industrial schematic.

Lesson 5: Piping Symbols

Topics

Piping Systems; Kinds of Diagrams; Projections; Joints; Fittings; Symbols

Objectives

- Explain the function of a valve in a piping system.
- Name the ways of joining pipe.
- Identify the symbols for various kinds of fittings and describe the function of each fitting.

Lesson 6: Piping Diagrams

Topics

Piping Systems; Valves; Identifying Piping Symbols; Reading a Simple Schematic; Reading a Piping Schematic

Objectives

- Give the purpose of a valve in a piping system.
- Explain the difference between a check valve and a cock valve.
- Identify the symbols for various types of valves.
- Demonstrate the ability to determine pipe size from a diagram.

Lesson 7: Hydraulic and Pneumatic Symbols

Topics

Fluid Power; Reservoirs and Receivers; Pumps and Compressors; Actuators; Valves; Piping and Tubing

Objectives

- Describe a fluid-power system.
- List and give the purpose of the main parts of a hydraulic system.
- List and give the purpose of the main parts of a pneumatic system.
- Identify pneumatic and hydraulic symbols on schematics.

Lesson 8: Hydraulic and Pneumatic Diagrams

Topics

Schematic Diagrams; Composite Symbols; Understanding Circuits; Hydraulic Circuit Diagram; Pneumatic Circuit Diagram; A More Complicated Diagram; Local Areas; Putting Local Areas Together

Objectives

- Describe a composite symbol.
- Explain the difference between a closed and an open hydraulic or pneumatic system.
- Identify the actuator in a hydraulic diagram.
- Explain the purpose of local areas on a hydraulic or pneumatic diagram.

Reading Schematics and Symbols

Lesson 9: Air Conditioning and Refrigeration Systems

Topics

A/C and R Systems; Refrigeration Subsystem; Water Subsystems; Air Distribution Subsystem; Control Subsystems; Electric Control Schematics; Electronic Control Schematics; Pneumatic Control Schematics

Objectives

- Describe the subsystems of an air conditioning system.
- Identify the symbols for air conditioning and refrigeration components.
- Explain the operation of an air conditioning and refrigeration control system.

Lesson 10: Welding and Joining Symbols

Topics

Welding; Methods of Welding; Joints; Welds; Symbols for Welds; Assembled Welding Symbol; Placement of Welds; Special Symbols; Reading Welding Symbols

Objectives

- Explain fusion welding.
- Name the main methods of fusion welding.
- Name the five types of joints and three ways of welding each joint.
- Demonstrate how to read and interpret a complete welding symbol.

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Making Measurements

Course 104: Making Measurements

Examines all aspects of basic measurement concepts and procedures, including accuracy and tolerance. Discusses techniques and devices for comparison measurements. Shows common methods for measuring volume, motion, force, temperature, fluid flow, and electricity. Explains how to use scales, rules, combination calipers, and micrometers. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Units of Measurement

Topics

Kinds of Units; Length; Area; Volume; Angles; Time; Speed and Velocity; Mass and Weight; Force; Work and Power; Pressure; Temperature; Electricity

Objectives

- Identify various units of measurement.
- State the definition of the joule, the coulomb, and the horsepower.
- Explain how to calculate pressure.
- Explain the difference between mass and weight.
- Demonstrate how to measure the volume of an object.
- Explain the difference between the Celsius scale and the Fahrenheit scale.

Lesson 2: Metric Measurement

Topics

History; Measuring Terms; Length; Area and Volume; Mass; Time; Frequency; Speed and Velocity; Acceleration; Force and Weight; Work and Energy; Power; Temperature; Electric Current; Light; Amount of Substance; Using SI Units

Objectives

- List the seven base units in the SI (metric) system.
- Name three derived units.
- Define work and power in SI units.
- Explain what power is and how it is measured.
- Name two metric measuring instruments and their U.S. Standard equivalents.

Lesson 3: Linear Measurement

Topics

Units of Linear Measurement; Measurement Error; Tolerances; Measuring Devices; Scales and Rules; Scribers and Dividers; Bevel Gauge; Calipers; Combination Square; Reading a Vernier Scale; Using a Micrometer; Reading a Micrometer

Objectives

- List five units used for making linear measurements.
- Demonstrate how to use a micrometer.
- Explain what each head of a combination square is used for.
- State the definition of parallax error.
- Define the different types of tolerance.

Lesson 4: Comparison and Surface Measurement

Topics

Comparison Measurement; Gauge Blocks; Measuring Screw Threads; Measuring Radius; Measuring Surface Texture; Hardness Testing; Testing Surface Coatings; Detecting Defects

Objectives

- Explain the difference between a continuous dial and a balanced dial on a dial indicator.
- the definition of pitch on a screw.
- Name two hardness tests.
- Explain why nondestructive testing is preferable to destructive testing on surface coatings.

Lesson 5: Measuring Bulk Materials

Topics

Bulk Solids; Storing and Handling Bulk Solids; Conveyors; Measuring Area; Measuring Volume; Weight, Mass, and Density; Weighing Bulk Materials; Measuring Lumber

Objectives

- Explain why weight-density and the angle of repose are important to workers who handle and store loose bulk material.
- Name the two types of conveyors and list three specific examples of each type.
- Name the three basic measurements of bulk materials.
- Demonstrate how to find the radius of a circle, given its area, and how to find the area of a circle, given its circumference.
- Demonstrate how to convert a typical order of lumber into board feet.

Lesson 6: Measuring Motion

Topics

Relative Motion; Displacement; Velocity; Acceleration; Average and Instantaneous Values; Motion on a Curved Path; Graphs of Motion

Objectives

- Name the three measurements of motion.
- State the definition of speed.
- Explain the difference between average and instantaneous velocity.
- Demonstrate how to interpret a graph of motion.
- Explain of the velocity of an object is shown on a graph of motion.

Making Measurements

Lesson 7: Measuring Forces

Topics

How Forces Act; Combining Forces; Force and Motion; Torque; Force-Measuring Instruments; Torque-Measuring Instruments; Analyzing Forces

Objectives

- Name both the metric and the U.S. Standard units of measurement for force, mass, and acceleration.
- State the definition of force.
- Demonstrate how to calculate torque.
- State an advantage of using a balance instead of a scale.
- Demonstrate how to draw a force diagram.

Lesson 8: Measuring Temperature

Topics

Temperature and Heat; Thermometers; Temperature-Sensing Materials; Digital and Analog Thermometers; Bourdon-Tube Thermometers; Bimetallic Thermometers; Electric Thermometers; Pyrometers; Response Time and Accuracy

Objectives

- Explain the difference between heat and temperature.
- Name four different scales for measuring temperature.
- Explain the use of heat-sensitive pellets, crayons, and paints.
- Explain how Bourdon tubes work.
- Explain how a pyrometer works.

Lesson 9: Measuring Fluids

Topics

States of Matter; Measuring Liquid Level; Viscosity; Flow Rate; Measuring Volume of Flow; Humidity; Density; Measuring Specific Gravity; Pressure; Measuring Pressure; Measuring Flow Rate by Pressure

Objectives

- State the definition of a fluid.
- Describe how liquids differ from gases.
- List the instruments used to measure the level of water.
- Name two instruments that measure the flow of fluids, and explain how they work.

Lesson 10: Measuring Electricity

Topics

Structure of Matter; Electricity; Electric Circuits; Electrical Units; Measuring Current; Measuring Potential Difference; Measuring Resistance; Measuring Power; AC and DC Measurements

Objectives

- List the parts of an atom.
- Define potential difference.
- Identify a wattmeter.
- Describe the difference between alternating current and direct current.
- Describe the difference between an ohmmeter and an ammeter.

Hand Tools

Course 107: Hand Tools

Begins with measuring tools, including a discussion of units of measurement. Examines the various kinds of wrenches and screwdrivers, their uses and handling techniques. Explains other hand tools by specialty: pipefitting tools, plumbing tools, electrician's tools, sheet metalworking tools, machinists' metal-working tools. Ends with hoisting and pulling tools. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Measuring Tools

Topics

Linear and Angular Measurement; Units of Linear Measurement; Rules and Measuring Tapes; Using Rules and Tapes; Calipers; Slide Calipers; Vernier Calipers; Micrometer Caliper; Using the Micrometer; Squares

Objectives

- Explain how to hold a rigid rule correctly when measuring an object and show from which point the measurement begins.
- Describe how to set lock joint transfer-type calipers.
- Identify vernier calipers.
- Explain how to take a measurement with a micrometer caliper.
- Name the parts of a combination square.

Lesson 2: Wrenches and Screwdrivers

Topics

Using Wrenches; Open-End Wrenches; Box-End Wrenches; Combination Wrenches; Socket Wrenches; Socket Handles; Socket-Screw Wrenches; Adjustable Wrenches; Torque Wrenches; Using Wrenches Safely; Using Screwdrivers; Standard Screwdrivers; Cross-Slot Screwdrivers; Spiral Ratchet Screwdrivers; Offset Screwdrivers; Driving a Screw; Removing a Screw; Restoring a Screwdriver Blade; Using Screwdrivers Safely

Objectives

- Identify types of materials used for making wrenches.
- Identify open-end, box-end, socket, socket-head, adjustable, torque, and striking-face wrenches.
- Describe two sizes that are important in identifying a socket wrench.
- Identify standard, Phillips, offset, and spiral-ratchet screwdrivers.
- List the steps to follow when driving a screw.

Lesson 3: Pipefitting Tools

Topics

Pipe Wrenches; Using a Pipe Wrench; Pipe Vises; Cutting Pipe; Reaming Pipe; Threading Pipe; Tapping Pipe; Cutting Tubing and Plastic Pipe; Flaring Metal Tubing; Caring for Pipe Tools

Objectives

- Identify a straight pipe wrench, a Stillson wrench, a chain pipe wrench, a strap wrench, and a compound-leverage wrench.
- Explain how to use a pipe wrench.
- Explain why a machinists' vise should not be used for holding pipe.
- Explain how to thread pipe.
- Explain how to clean a pipe tool.
- Explain how to cut and flare tubing.

Lesson 4: Plumbing Tools

Topics

Plumbing Codes; Plumbing System; Joining Copper Pipe; Tube Bending; Cutting Cast-Iron Pipe; Joining Cast-Iron Pipe; Assembling Plastic Pipe; Force-Cup Plungers; Augers; Line-Clearing Tools; Sewer Tapes; Special Wrenches; Measuring Pipe

Objectives

- Explain how to use a mechanical tube bender.
- List the steps in joining hubless pipe.
- Explain why the drain pipe should be completely covered by the force cup.
- Name the criteria used in selecting line clearing tools.
- List the steps in measuring pipe when using the center-to-center measuring systems.

Lesson 5: Electrician's Tools

Topics

The Electrician; EMT Bender; Correcting Knocked Over Stubs; Bending Rigid Conduit; Assembling Rigid Conduit; Knockout Punches; Fish Tapes; Pliers; Wire and Cable Strippers; Electrician's Screwdrivers; Test and Safety Equipment

Objectives

- Explain how to use an EMT bender and a neon circuit tester.
- List the parts of a knockout punch.
- Name the uses of the all-purpose tool.

Lesson 6: Woodworking Tools

Topics

Handsaws; Crosscut Saws; Ripsaws; Special-Purpose Saws; Planes; Scrapers; Drills and Bits; Chisels; Levels; Plumb Bobs; Hammers and Nail Sets

Objectives

- Describe the difference between a ripsaw and a crosscut saw.
- Explain the difference between a compass saw and a keyhole saw.
- Describe the different types of planes.
- Identify a Forstner bit.
- Explain the working of a plumb line.

Hand Tools

Lesson 7: Masonry, Plastering, and Glazing Tools

Topics

Concrete and Mortar; Preparing Mortar; Working with Bricks and Mortar; Tuckpointing; Working with Concrete; Edging, Jointing, and Finishing; Repairing Plaster; Repairing Wallboard; Cutting Glass; Installing Glass; Safety on the Job

Objectives

- Explain how to mix a small batch of mortar.
- List the uses of a trowel.
- Define tuckpointing.
- Explain why flat concrete surfaces must be screeded.
- Explain how to repair one of the following problems: (a) small plaster cracks, (b) shrinkage cracks, or (c) loose or bulging plaster.
- Explain how to replace a broken pane of glass in a window.

Lesson 8: Sheet Metalworking Tools

Topics

Sheet Metal; Sheet Metal Gauges; Layout Tools; Dividers; Punches; Rivets and Riveting Tools; Metal-Cutting Chisels; Using a Chisel; Hammers; Metal-Cutting Snips; Dressing; Notchers; Bench Stakes; Forming Tools; Hand Seamer; Soldering; Sheet Metal Safety

Objectives

- Identify different types of snips and punches.
- Identify the bench stakes discussed in this Lesson.
- List six safety practices to follow when working with sheet metal.
- Describe different types of sheet metal.

Lesson 9: Metalworking Tools

Topics

Vises; Hacksaws; Using Hacksaws; Files; File Cuts; File Specifications; Selecting a File; Using Files; Taps; Tap Sizes; Using Taps; Dies; Thread Classes; Using Dies; Reamers; Using Reamers

Objectives

- Select the proper hacksaw blades for cutting various materials.
- Explain the difference between single-cut and double-cut files.
- List the types of taps usually found in a tap set.
- Explain how to cut an external thread on a bolt, screw, or stud.
- Explain how to remove a reamer from a hole.

Lesson 10: Hoisting and Pulling Tools

Topics

Hoisting with Rope; Knots; Wire Rope; Slings; Sling Angles; Sling Hitches; Center of Gravity; Sling Spreader Beams; Block and Tackle; Chain Fall; Chain Load Pullers; Machine Part Pullers; Jaw Pullers; Slide-Hammer Pullers; Choosing the Proper Puller

Objectives

- Explain how to prevent synthetic and fiber rope from unraveling.
- Explain how individual wires and strands of wire are formed into wire rope.
- Identify the most appropriate sling for use near corrosive chemicals.
- Identify a slide-hammer puller.
- Describe different kinds of slings and loads.

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Portable Power Tools

Course 108: Portable Power Tools

Explains the uses, selection, safety, and care of industrial power tools: electric drills, electric hammers, pneumatic drills and hammers, screwdrivers, nutrunners, wrenches, linear-motion and circular saws, routers and planes, electric sanders, grinders, and shears. Covers tool sharpening techniques for selected tools. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Electric Drills

Topics

Parts of Electric Drills; Light-Duty Drills; Heavy-Duty Drills; Accessories; Drill Sizes; Drill Bits; Preparing to Drill; Using the Electric Drill; Electric Drill Maintenance; Drill Safety

Objectives

- Name four parts that are common to both the light-duty drill and the heavy-duty drill.
- Name the parts of a drill bit.
- Explain how to drill a blind hole.
- Explain how to inspect a drill bit, both visually and through testing.
- List the safety rules to follow when using electric power tools.

Lesson 2: Electric Hammers

Topics

Types of Hammers; Operating Electric Hammers; Bits and Chisels; Core Bits; Self-Drilling Anchors; Mechanical Safety; Electrical Safety; Environmental Safety

Objectives

- Explain the difference in hammering action between a percussion hammer and a rotary hammer.
- Select the proper chisel to use for each of the following jobs: brick cleaning; general demolition work; edging, chipping, and channeling; and removing floor tile.
- List the precautions that should be taken to ensure electrical safety when using an electric hammer.
- Name two safety items to use when operating an electric hammer in damp or wet areas.

Lesson 3: Pneumatic Drills and Hammers

Topics

Air Power; Types of Pneumatic Drills; Sizes of Pneumatic Drills; Bits for Pneumatic Drills; Preparing to Drill; Operating Pneumatic Drills; Types of Pneumatic Hammers; Chipping and Scaling; Drilling; Riveting; Tampers; Needle Scalers; Diggers; Lubrication and Maintenance

Objectives

- Explain how drill size is determined.
- Describe the chiseling action of a bull point chisel when it is used to clean masonry seams.
- Describe how to use a rivet buster.
- Explain drill speed requirements.
- Identify various types of drill bits used in pneumatic hammers.

Lesson 4: Screwdrivers, Nutrunners, and Wrenches

Topics

Screwdrivers and Nutrunners; Clutch Mechanisms; Power Wrenches; Bits and Sockets; Operating Power Screwdrivers and Wrenches; Lubricators and Moisture Separators; Tool Safety

Objectives

- Identify the operating advantages of pneumatic tools.
- Define stalling torque.
- Describe the clutch action of direct drive, positive drive, and adjustable torque drive.
- Explain how to install a bit in an electric screwdriver.
- Describe how to install multiple fasteners correctly in a circular pattern.
- List safety rules to follow when using power screwdrivers and wrenches.
- Describe the difference between pneumatic and electric nutrunners.

Lesson 5: Linear-Motion Saws

Topics

Straight-blade Power Saws; Saber Saws and Blades; Plunge and Straight Cutting; Cutting Metals; Reciprocating Saws and Blades; Band Saws

Objectives

- List other names for both the saber saw and the reciprocating saw.
- Describe the cutting action of a saber saw.
- Explain how to draw a saw blade with regular set teeth and one with wavy set teeth.
- Explain how to plunge cut a rectangular opening.
- List the types of band saw blades described in this Lesson and a few characteristics of each.

Lesson 6: Circular Saws

Topics

Circular Saws; Using the Circular Saw; Circular Saw Blades; Special Saw Blades; Crosscutting; Ripping; Angular Cutting; Plunge Cutting; Notching and Grooving; Cutoff Wheels; Arbors and Arbor Adapters; Circular Saw Accessories; Safety Rules

Objectives

- Name the major parts of a circular saw.
- Describe the cutting action of a circular saw.
- List the factors that determine feed speed.
- State the definition of an arbor.
- Identify different types of blades.

Portable Power Tools

Lesson 7: Routers and Planes

Topics

Router Characteristics; Collet Chucks; Bits; Using a Router; Direction of Feed; Grooves and Dadoes; Rabbet Cuts; Decorative Trim; Circular Cuts; Using Templates; Hinge-Butt Mortising; Jointing; Plane Characteristics; Using a Plane; Safety

Objectives

- Discuss how to use a router.
- Name the major parts of a router.
- Explain how to use a router and bit.
- Identify a rabbeting joint, a straight joint, and a mortising joint.
- Explain how to adjust and use a power plane.

Lesson 8: Electric Sanders

Topics

Belt Sanders; Installing a Sanding Belt; Using the Belt Sander; Belt Sander Lubrication; Motor Maintenance; Pad Sanders; Loading the Sander; Using the Pad Sander; Pad Sander Maintenance; Disk Sanders; Using the Disk Sander; Disk Assembly; Disk Sander Maintenance Safety

Objectives

- Explain how to install a sanding belt.
- Identify different types of sanding belts.
- Explain how to flush the gear chamber of a belt sander.
- Discuss the assembly of a sanding disk.
- List the safety rules to follow when using a disk sander.

Lesson 9: Grinders and Shears

Topics

Selecting a Grinder; Grinding Wheels; Mounting Grinding Wheels; Using the Grinder; Grinder Maintenance: Safety; Selecting Shears; Using Shears and Nibblers

Objectives

- State the meaning of each symbol in the six-symbol standard marking system for grinding wheels.
- Explain the correct procedure for mounting a grinding wheel.
- List safety rules to follow when using a grinder.
- Discuss how to maintain grinders.

Lesson 10: Tool Sharpening

Topics

Reasons for Sharpening; Whetstones; Using a Bench Grinder; Sharpening Chisels; Sharpening Drill Bits; Sharpening Screwdrivers; Sharpening Pointed Tools; Sharpening Reamers; Sharpening Taps and Dies; Other Sharpening Tools

Objectives

- State the reasons for sharpening tools.
- Explain the use of whetstones.
- Identify a bench stone.
- Explain how to sharpen taps, dies, screwdrivers, and chisels.

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Industrial Safety and Health

Course 109.1: Industrial Safety and Health

Explains government involvement in ensuring a safe workplace. Discusses safety in various situations. Discusses personal protective equipment and fire safety. Includes expanded coverage of many health hazards. Covers ergonomics, environmental responsibility and importance of maintaining a safe work environment. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.2 CEU** for this program.

Lesson 1: Introduction to Safety and Health

Topics

Responsibility for Safety; Unsafe Acts and Conditions; Health Hazards; Accidents; Handling Emergencies; Safety Off the Job

Objectives

- Define the terms accident and hazard.
- Name and define the four main types of hazards.
- List and define various types of accidents.
- Compare meanings of unsafe act and unsafe condition.
- Name the three ways in which a toxic substance can enter your body.
- List ways in which a company must plan for emergencies.
- Tell the main reason for prompt accident investigation.

Lesson 2: Government Safety and Health Regulations

Topics

The Rights of Employees and Employers; OSHA Standards and Inspections; Taking Immediate Action; Records and Reports; OSHA's Hazard Communication Standard; SDSs; NIOSH; EPA; OSHA

Objectives

- State the purpose of the OSHA Act.
- List the specific rights of employees under the Act.
- Explain what to do in a dangerous work situation.
- List things that you can do to help keep your workplace in compliance with OSHA standards.
- Explain the function of each of the following agencies: NIOSH, EPA.
- List the four main objectives of OSHA's Hazard Communication Standard.
- Tell what information can be found on an SDS.

Lesson 3: Personal Protective Equipment

Topics

Work Clothes; Special Body Protection; Gloves; Head, Eye, Face, Hearing, and Foot Protection; Safety Harnesses and Lifelines; Respiratory Protection

Objectives

- List employer and employee responsibilities related to PPE.
- Tell why work clothing can be dangerous if it fits poorly.
- Explain the importance of proper glove selection when handling chemicals.
- Describe the proper fit of a hard hat.
- Compare and contrast everyday eyeglasses, industrial safety glasses, and safety goggles.
- Identify noise levels that require hearing protection.
- Name the two basic kinds of respirators.

Lesson 4: Chemical Safety

Topics

Physical Hazards; Health Hazards; Exposure Routes; Control of Chemical Hazards; Spill Response; First Aid

Objectives

- Define chemical hazard, physical hazard, and health hazard.
- Name three kinds of physical hazards.
- Name and describe at least four kinds of health hazards.
- Identify common symptoms of chemical exposure.
- List three health hazard exposure routes.
- Name three ways of controlling chemical hazards and exposures.
- Explain first aid procedures to follow when you are exposed to a hazardous chemical.

Lesson 5: Tool Safety

Topics

Screwdrivers; Wrenches; Pliers; Hammers and Mallets; Chisels and Punches; Knives; Electric Tools; Pneumatic Tools; Gasoline-Powered Tools

Objectives

- Name at least three causes of hand tool accidents.
- List one safety rule to follow when using each of the following: screwdriver, wrench, pliers, hammer, chisel, knife.
- Describe proper and improper dress for working with rotating power tools.
- Explain the importance of grounding electric tools.
- Name two hazards involved in pneumatic tool use and explain how to guard against them.
- Explain proper handling and storage of gasoline.

Lesson 6: Material Handling

Topics

Avoiding Injuries; Rules for Lifting; Teamwork; Hand Tools and Accessories; Power-Operated Handtrucks; Powered Industrial Trucks; Dock Safety; Conveyors; Hoists and Cranes; Receiving and Storing Materials; Corrosive and Flammable Liquids

Objectives

- List simple safety procedures and precautions related to material handling.
- Describe how to lift, carry, and put down a load.
- Explain safety principles for working with or around industrial trucks.
- Discuss safety rules for working with or around conveyors, slings, and hoists.
- Describe how and where to store materials.

Industrial Safety and Health

Lesson 7: Working Safely with Machinery

Topics

Point-of-Operation Guards; Fixed Guards; Special Guards; Power Transmission Guards; Other Safety Devices; OSHA Lockout/Tagout Procedures

Objectives

- Identify a machine's point of operation and other pinch points, and explain why they are dangerous.
- Identify different kinds of mechanical safeguards, and explain why they are necessary.
- Define zero energy state.
- Describe the lockout/tagout procedures established by the OSHA energy control standard.

Lesson 8: Working Safely with Electricity

Topics

The Electric Circuit; Injuries from Electricity; First Aid for Shock Victims; National Electrical Code; Static Electricity

Objectives

- Define the following terms: electric current, circuit, potential difference, ampere, watt, ohm, and volt.
- State Ohm's Law.
- Explain the function of each wire in a simple electric circuit and tell the color(s) used to identify each.
- List the three factors that affect the severity of an electric shock.
- Describe the effects of electric current on the human body.
- Tell the three most important points about first aid for shock victims.
- Explain how static electricity is generated, why its accumulation can be dangerous, and how it can be avoided.

Lesson 9: Electrical Equipment Safety

Topics

Grounding; Ground Faults; Fuses and Circuit Breakers; Portable Power Tools; Hazardous Electrical Locations; Basic Rules of Electrical Safety

Objectives

- Explain the importance of proper grounding.
- Define the term "ground fault" and explain how ground faults occur.
- Explain the purpose and operation of the following devices: GFCI, fuse, circuit breaker.
- Identify typical hazardous electrical locations.
- Explain the purpose of explosion-proof and intrinsically safe electrical equipment.
- List at least two electrical safety rules in each of the following areas: clothing, equipment, water, lockout/tagout.

Lesson 10: Fire Safety

Topics

Causes of Fires; Classes of Fires; Fire and Explosion Hazards; Preventing Fires and Explosions; Fire-Fighting Substances; Fire Hoses; Portable Fire Extinguishers; Protecting Yourself

Objectives

- Name and give the definition of the four classes of fires.
- Define the terms flash point and spontaneous combustion.
- Name the fire-fighting agents, and explain how they work and when to use them.
- Explain the use of at least two different types of portable fire extinguishers.
- List three ways of preventing fires.
- Explain fire hose and fire extinguisher maintenance.

Lesson 11: Protecting Your Health

Topics

Ergonomics; Noise; Radiation; Asbestos, Dusts, and Lung Disease; Fetal Protection; The Environment

Objectives

- Define ergonomics and tell how poor ergonomic conditions affect the body.
- List three actions that you can take to protect your hearing.
- Tell the cause of each of the following lung diseases: asbestosis, lung cancer, brown lung, black lung, silicosis.
- Contrast ionizing and nonionizing radiation.
- Compare and contrast personal and background sampling.
- Explain the importance of protecting women from exposure to certain chemicals.
- State the purpose of the EPA.

Lesson 12: A Safe Work Environment

Topics

Industrial Housekeeping; Walking and Working Surfaces; Safety in Traffic; Working at Elevations; Ladders; Scaffolds; Industrial Lighting; Safety in Extreme Heat; Working in Confined Spaces; Welding and Cutting Safety

Objectives

- Explain the importance of industrial housekeeping.
- List safety measures related to walkways, stairs, and floor openings.
- Tell how to protect yourself and others when working in traffic paths.
- Describe at least three hazards involved with each of the following and tell how to safeguard against them: working at elevations and working in confined spaces.
- Calculate the proper placement of a straight ladder based on its working length.
- Name two kinds of scaffolds and give at least one safety rule associated with each.
- List symptoms of heatstroke, heat cramps, and heat exhaustion.
- Name two major safeguards necessary when welding.
- Explain how to handle and store cylinders safely.

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Troubleshooting Skills

Course 110: Troubleshooting Skills

Explores the subject of troubleshooting and the importance of proper maintenance procedures. Covers working with others, aids in communication, and trade responsibilities. Outlines troubleshooting techniques and aids, using schematics and symbols. Focuses on specific maintenance tasks, breakdown maintenance, and planned maintenance. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Introduction to Troubleshooting

Topics

Troubleshooting; Troubleshooting Skills; Troubleshooting Duties; Troubleshooting Aids; Mechanical Troubleshooting; Electrical Troubleshooting; Importance of Maintenance; Maintenance Organization; Maintenance Personnel; Scheduling; Challenge of Maintenance

Objectives

- Tell why efficient troubleshooting is important in a production plant.
- Name the four common troubleshooting aids.
- List the steps in troubleshooting a machine.
- List the steps in troubleshooting a system.
- Describe a typical maintenance organization.

Lesson 2: Working with Other People

Topics

Communicating with People; People Skills; Human Behavior; Communication Cycles; Aids to Communicating; Being Tactful; Preventing Misunderstandings; Working with Older Persons; Trade Responsibilities; Differences of Opinion; You and Your Supervisor; Upgrading Your Skills

Objectives

- Tell why good communication between plant personnel is needed.
- List the ways a person usually sees himself/herself.
- Explain the communication cycle.
- Explain the correct method of delivering a written message from your supervisor to another person.

Lesson 3: Troubleshooting Techniques

Topics

Job Responsibilities; Recognizing Normal Operations; Learning About Normal Operations; Simple Testing and Observation; Reducing Downtime; Routine Repairs; Emergency Repairs

Objectives

- List the steps to recognizing normal machine operations.
- List the questions you should ask yourself when a machine fails.
- List the signs of a machine in need of service.

Lesson 4: Aids to Troubleshooting

Topics

Equipment Repairs; Drawings and Blueprints; Sketches; Manufacturer's Literature; Service Representatives; Planned-Maintenance Records; Machine Records and Work Orders; Electrical Test Equipment; Mechanical Instruments; Temperature-Measuring Instruments

Objectives

- Describe a blueprint.
- List the information that should be recorded in a machine equipment record.
- Identify calibration standards.
- Identify a multimeter (VOM).
- Identify different troubleshooting test equipment.

Lesson 5: Preparing for Troubleshooting

Topics

Troubleshooting Responsibilities; Tools for Troubleshooting; Parts and Supplies; Safety Rules; Example of Troubleshooting; Charts and Diagrams for Troubleshooting; Correcting Malfunctions; Power-Transmission Equipment; Drive and Conveyor Belts; Drive and Conveyor Chains

Objectives

- List the information you must know about mechanical or electrical systems before you can troubleshoot them successfully.
- Name the commonly used items that should be carried in every troubleshooter's tool box.
- List the steps to follow in reading a pneumatic or hydraulic schematic.
- List the responsibilities of a troubleshooter.

Lesson 6: Using Schematics and Diagrams

Topics

Using Schematic Diagrams; Piping Schematics; Compressor and Engine Piping Schematics; Hydraulic and Pneumatic Schematics; Pneumatic Circuits; Pneumatic-Hydraulic Schematics; Electrical Schematics; Motor-Starting Circuits; Plant Lighting Diagrams; Plant Lighting Controls; Electrical Troubleshooting Charts

Objectives

- Discuss how to use schematics when troubleshooting.
- Identify differences in schematics.
- Explain how to use a troubleshooting chart.

Troubleshooting Skills

Lesson 7: Solving Mechanical Problems

Topics

Bearing Problems; Pump Problems; Piping Systems; Flexible Hose; Compressed-Air Equipment; Hydraulic Systems; Heating, Ventilating, and Air Conditioning; Refrigeration Equipment; Pollution-Control Equipment; Building Maintenance

Objectives

- Identify bearing wear problems.
- Identify pump failure problems and solutions.
- Identify types of hosing.
- Identify different plant equipment and their problems.

Lesson 8: Solving Electrical Problems

Topics

Power Generation and Distribution; Feeders, Subfeeders, and Branch Circuits; Fuses and Circuit Breakers; Current Capacity of a Wire; Understanding Basic Principles; Diagnosing Trouble; Testing for Continuity; Electrical Safety; Communication and Diagrams; Using Building Lighting Diagrams; Troubleshooting with Electrical Diagrams; Electrical Instruments

Objectives

- State the definition of switchgear.
- Identify current voltage characteristics of wire.
- List the safety rules to follow when working with electrical equipment.
- Identify a pictorial diagram, a block diagram, and a schematic diagram.
- Explain how to troubleshoot an electric problem.

Lesson 9: Breakdown Maintenance

Topics

Definition of Breakdown Maintenance; How Breakdown Maintenance Works; Good Breakdown Maintenance; Work-Order Procedures; Preparing for Emergencies; Skills for Emergency Work; Maintenance Parts and Supplies; Breakdowns in Automatic Machinery; Using Downtime; Resurfacing Machine Parts

Objectives

- Explain what to do if you are the first member of the emergency crew.
- Explain the spare parts requisition form.
- Discuss the four main parts of practical machine maintenance.

Lesson 10: Planned Maintenance

Topics

Definition of Planned Maintenance; Importance of Planned Maintenance; Frequency of Planned Maintenance; Benefits of Planned Maintenance; Unscheduled Maintenance; Parts Requiring Planned Maintenance; Keeping Maintenance Records; Inspection Records; Lubrication; Using Lubrication Charts

Objectives

- State the definition of planned maintenance.
- List the information that should be included on record sheets or file cards as part of the machine inventory.
- List the benefits to be accrued from an effective lubrication program.
- Describe the proper sag in a drive chain.
- Explain how to service a battery properly.

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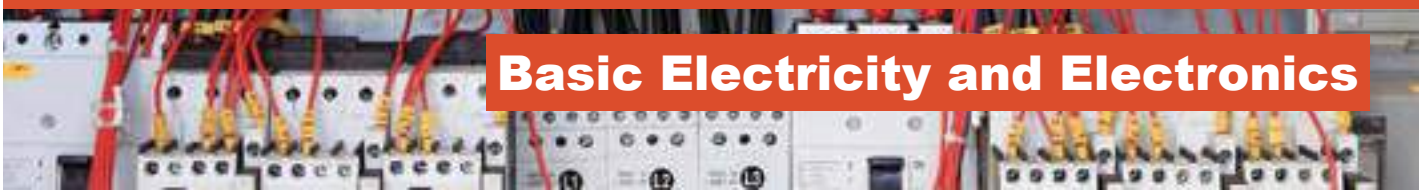

Basic Electricity and Electronics

Course 201: Basic Electricity and Electronics

Covers basic, nonmathematical approach to understanding principles of electricity. Introduces electron theory, static electricity, electrons in motion, and magnetism. Covers basic methods of measuring current, voltage, and resistance. Explains circuit components—conductors, insulators, resistors, capacitors—and simple Ohm's Law calculations for DC and AC circuits. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Introduction to Electricity

Topics

History of Electricity; Language of Electricity; Structure of Matter; Structure of Atoms; Electron Shells; Transferring Charges; Electrical Forces; Electrical Terms

Objectives

- Describe the structure of an atom.
- Tell the difference between a compound and an element.
- Explain how electrical forces cause objects to attract or repel other objects.
- Describe electron flow.
- State the definition of a cell.

Lesson 2: Static Electricity

Topics

Nature of Static Electricity; Generating Static Electricity; Effects of Static Electricity; Eliminating Static Electricity; Static Eliminators; Effects of Humidity; Static Charges on a Liquid Surface; Static Charges on Rubber-Tired Vehicles; Static Charges on Dusts and Fibers; Static Charges in Process Machinery; Using Static Electricity; Measuring Static Electricity

Objectives

- List the conditions that must exist in order for static electricity to cause ignition.
- List the common causes of static electricity in an industrial plant.
- State the definition of bonding.
- Explain how liquid affects a static charge.
- State the definition of grounding.
- Explain the relationship between humidity and static electricity.

Lesson 3: Current Electricity

Topics

Electric Current and Energy; Electricity from Chemical Action; Primary Cells; Secondary Cells; Batteries; Electricity from Electromagnetism; Electricity from Contact; Electricity from Heat; Electricity from Light; Electricity from Deformation

Objectives

- List the main methods of producing potential difference.
- State the main difference between a primary cell and a secondary cell.
- Explain how to connect cells in parallel and in series.
- Describe how a photoelectric device works.
- Identify potential hazards when recharging batteries.

Lesson 4: Magnetism

Topics

Discovery of Magnetism; Definition of a Magnet; Magnetic Forces; Molecular Theory of Magnetism; Magnetic Fields; Magnetism and Electricity; Left-Hand Rules; Using the Left-Hand Rules; Electromagnets; Industrial Uses of Magnets

Objectives

- State the most basic law of magnetic force.
- Describe how magnetic force operates.
- Describe the left-hand rule for magnetic field direction.
- Describe an electromagnet.
- Explain how to use lifting magnets, magnetic pulleys, and magnetic clocks.

Lesson 5: Current, Resistance, and Potential Difference

Topics

Electric Current; Resistance; Potential Difference; Ohm's Law; Resistance and Voltage Drop; Measuring Current; Measuring Potential Difference; Measuring Resistance

Objectives

- State the characteristics of an electrical conductor and an electrical insulator.
- State the definition of electric current.
- Explain the relationship of potential difference to the flow of electric current.
- State the definition of Ohm's Law.
- Identify the purpose and parts of an ammeter.

Lesson 6: Electrical Components

Topics

Resistance; Resistors; Fixed Resistors; Resistor Color Code; Resistor Power Rating; Tapped Resistors; Variable Resistors; Capacitors; Capacitance; Types of Capacitors; Connecting Capacitors; Induction; Mutual Induction; Inductance; Inductors; Solenoids and Relays

Objectives

- Identify symbols for resistors, capacitors, and relays in an electric circuit diagram.
- Explain the operating principles of resistors, capacitors, and inductors.
- State the meaning of each band in the resistor color-code system.
- List the factors to consider when choosing a resistor.
- Explain how to connect capacitors in parallel and in series.

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Basic Electricity and Electronics

Lesson 7: Conductors

Topics

Conductors and Insulators; Conductors; Conductor Sizes; Conductor Classification; Insulation Properties; Insulating Tapes; Protecting Conductors; Flexible Conduit; Conduit Fill; Splicing Conductors

Objectives

- Explain the difference between a conductor and an insulator.
- Identify a bare conductor, a covered conductor, an insulated conductor, a stranded conductor, a cable, and a cord.
- State the definitions of insulation resistance and dielectric strength.
- Select the best tapes for insulating splices, restoring the outer protecting covering on a splice, and connecting motor leads.
- Explain how to make a pigtail splice and a fixture splice.
- State the purposes of cable protection.

Lesson 8: DC Circuits

Topics

DC Characteristics; Ohm's Law; Applying Ohm's Law; Circuit Power; Series Circuits; Parallel Circuits; Series-Parallel Circuits; Open and Short Circuits

Objectives

- State the difference between ac and dc.
- Solve for R, E, I, and P in a simple electrical problem.
- Solve for potential difference, current, and resistance in a series and parallel circuit.

Lesson 9: AC Circuits

Topics

Advantages of Alternating Current; Generating Alternating Current; Effective and Average Values; Electrical Degrees; Resistance in AC Circuits; Inductance in AC Circuits; Capacitance in AC Circuits; Current in AC Circuits; Power in AC Circuits

Objectives

- Explain the importance of the transformer in ac electricity.
- Explain what a complete cycle of ac consists of and how it is produced.
- State the definition of ac inductance.
- List the ways inductive reactance differs from resistance.
- Explain the difference between the terms in-phase and out-of-phase in an ac circuit.

Lesson 10: Electronics

Topics

Development of Electronics; Electron Motion in a Vacuum Tube; Kinds of Cathodes; Vacuum-Tube Diode; Vacuum-Tube Triode; How a Triode Amplifies; A Vacuum-Tube Circuit; Semiconductors; Semiconductor Junctions; Kinds of Semiconductor Diodes; Transistors: Kinds of Transistors; Microprocessors

Objectives

- Name the parts of a vacuum tube, and describe the function of each part.
- Explain the difference between p-type semiconductor materials and n-type semiconductor material.
- List the parts of a transistor.
- State the definition of an integrated circuit.

Electrical Measuring Instruments

Course 204.1: Electrical Measuring Instruments

Covers the principles on which electrical test instruments operate. Basic instruments covered include voltmeter, ammeter, wattmeter, ohmmeter, and megohmmeter. Covers AC metering, split-core ammeter, use of current and potential transformers. Includes detailed coverage of modern multimeters. Explains functions and uses of oscilloscopes. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **0.5 CEU** for this program.

Lesson 1: Principles of Meter Operation

Topics

Meter Principles; General Digital Meter Design; Integrating ADCs; Digital Displays; Sensitivity, Accuracy, and Resolution; Introduction to Analog Meters; The D'Arsonval Movement; Electrodynamometer Movements; Moving-Vane Meters; Magnetic Shielding; Parallax Error; Analog Instrument Sensitivity; Analog Accuracy

Objectives

- Define the terms digital meter and analog meter.
- Describe the purpose of the analog-to-digital converter in a digital meter.
- Identify and label graphs of integrator output from a dual-slope integrating meter.
- Explain how time is related to voltage measurement in an integrating digital meter.
- Differentiate among the terms accuracy, sensitivity, and resolution.
- Explain how a D'Arsonval meter movement works.
- Describe the parallax effect, and explain how to avoid it when using an analog meter.
- State the sensitivity formula for an analog meter.

Lesson 2: Ammeters, Voltmeters, and Wattmeters

Topics

Measurement Considerations; Current Measurement; Measuring Direct Current; Multirange Ammeters; Hooking Up an Ammeter; Measuring Alternating Current; Clamp-On Ammeters; Voltmeters; Using a Voltmeter; Wattmeters

Objectives

- Describe the differences and similarities between an analog ammeter and a voltmeter.
- Explain how ammeters and voltmeters are protected internally from overcurrent.
- Explain how a make-then-break switch works.
- Identify which meters should be connected in series in a circuit and which should be connected in parallel.
- Describe how an analog wattmeter works.
- Explain how it is possible to overload a wattmeter, even with the meter's pointer at less than full-scale deflection.

Lesson 3: Resistance Measurement

Topics

Measuring Resistance with an Ohmmeter; Ohmmeter Currents Are Small; Checking and Calibrating an Ohmmeter; How Does a Multirange Ohmmeter Work?; Shunt Ohmmeters; Advantages and Disadvantages of Shunt Ohmmeters; Megohmmeters; How to Use a Megohmmeter

Objectives

- Explain characteristic differences between a series ohmmeter and a shunt ohmmeter.
- Explain why ohmmeter scales read from right to left, instead of left to right, and why they are nonlinear.
- Describe the internal circuits and basic operation of an opposed-coil megohmmeter.
- State the primary safety precaution to take when using an ohmmeter.
- Describe two methods used by ohmmeter manufacturers to extend the range of their instruments.
- Explain how to test for opens, shorts, and grounds, using a megohmmeter.
- Describe how to make zero-adjustments on ohmmeters and megohmmeters.
- Explain why variable resistors are needed in battery-powered ohmmeters.

Lesson 4: Multimeters

Topics

The Multimeter; Guidelines for Using a Multimeter; An All-Purpose Graphical DMM; More Advanced Meter Functions; Multimeter Accessories; Multimeter Safety

Objectives

- Demonstrate how to measure ac and dc current and voltage with a multimeter.
- Describe the function of a current probe.
- Explain how to isolate the source of a glitch with a graphical multimeter.
- Demonstrate how to read the screen display of a graphical multimeter in the Trend mode.
- Explain why you set a meter to its highest range before taking your first measurement.
- Define autoranging and auto-polarity.
- List three safety precautions to take when using multimeters.

Electrical Measuring Instruments

Lesson 5: Oscilloscopes

Topics

Who Needs an Oscilloscope?; Kinds of Oscilloscopes; How an Analog Oscilloscope Works; Triggering; Digital Oscilloscopes; Dual-Trace Oscilloscopes; Real-Time vs Sampling Oscilloscopes; Selecting the Right Oscilloscope; Oscilloscope Controls; Probes; Basic Measurement Procedures; Using the Oscilloscope in Troubleshooting

Objectives

- Describe how an analog oscilloscope works.
- Describe advantages of a digital oscilloscope over an analog oscilloscope.
- Demonstrate how to measure voltage with an oscilloscope.
- Show two methods of determining phase angles with an oscilloscope.

Electrical Safety and Protection

Course 205.1: Electrical Safety and Protection

Examines electrical hazards and stresses the importance of electrical safety. Covers the equipment and procedures necessary to work safely with electricity, including PPE, lockout/tagout, and first aid. Explains the importance of grounding. Describes many kinds of fuses, circuit breakers, and motor protection devices and their uses. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **0.7 CEU** for this program.

Lesson 1: Electrical Hazards

Topics

The Importance of Electrical Safety; The Electric Circuit; Electric Shock; Electric Arc; Basic Rules of Electrical Safety; Hazardous Electrical Locations; Additional Hazards

Objectives

- List the three main factors that determine the effect of electric current on the human body.
- Explain what to do if a person is a victim of electric shock.
- Name four precautions you can take to guard against electric shock.
- Define the term qualified person.
- Summarize the basic rules of electrical safety.

Lesson 2: Electrical Safety Equipment

Topics

Work Clothes; Personal Protective Equipment; Special Body Protection; Foot Protection; Gloves; Head Protection; Eye Protection; Face Protection; Safety Harnesses and Lifelines; Respiratory Protection; Lockout Devices; Barricade Tape; Electrical Tools; Voltage Testers

Objectives

- Describe appropriate clothing and PPE to wear when working with electricity.
- Explain first aid procedures for eyes.
- Describe the devices used to lock out power.
- Tell how to keep plant personnel out of an area where electrical work is being performed.
- Explain the purpose of a voltage tester.

Lesson 3: Electrical Safety Procedures

Topics

Energy Control; Lockout/Tagout Procedures; Using Power Tools Safely; Power Tool Safety Rules; Recognizing Electric Shock Victims; First Aid for Shock Victims

Objectives

- Explain the concepts of energy control and zero energy state.
- Summarize the OSHA lockout procedure.
- Explain how portable power tools are grounded.
- List some common symptoms of electric shock.
- Summarize the steps involved in administering CPR.

Lesson 4: The National Electrical Code®

Topics

Overview of the *NEC*; Chapter 1: General *NEC*; Chapter 2: Wiring and Protection; Chapter 3: Wiring Methods and Materials; Chapter 4: Equipment for General Use; Chapter 5: Special Occupancies; Chapter 6: Special Equipment; Chapter 7: Special Conditions; Chapter 8: Communications Systems; Chapter 9: Tables; Informative Annexes

Objectives

- Understand the purpose and scope of the National Electrical Code.
- Define key terms related to the National Electrical Code.
- Determine requirements for electrical installations.
- Locate and reference common National Electrical Code articles.
- Identify common calculation tables.

Lesson 5: Grounding, Ground Faults, and Short Circuits

Topics

Equipment Grounding; Circuit Grounding; Protection Against Ground Faults; Transformer Grounding; Effects of Impedance; Grounding Through Enclosures; Visual Indication of Ground for Ungrounded Circuits; Grounded Conductor Alarms; Detecting Faults Automatically; Static Electricity

Objectives

- State the reason why circuits should be grounded.
- Explain how to test a circuit for proper grounding.
- Explain how a ground-fault circuit interrupter works.
- Contrast current electricity and static electricity and explain why each can be hazardous.
- Identify the correct extinguisher to use on flammable liquid fires and on energized electrical equipment fires.

Lesson 6: Fuses and Circuit Breakers

Topics

The Purpose of a Fuse; Lead-Wire Fuses; Cartridge Fuses; Dual-Element Cartridge Fuses; Current-Limiting Fuses; Power Fuses; Cartridge Fuse Classes, Sizes, and Ratings; Installing Cartridge Fuses; Plug Fuses; Glass-Tube Fuses; Kinds of Circuit Breakers; Magnetic Circuit Breakers; Thermal-Magnetic Circuit Breakers; Ambient-Compensated Circuit Breakers; Molded-Case Circuit Breakers; Low-Voltage Power Circuit Breakers; Circuit Breaker Tripping; Circuit Breaker Reset and Fuse Replacement

Objectives

- Explain how a dual-element cartridge fuse works.
- List the NEC rules on installing fuses.
- Explain how a circuit breaker works.
- Describe molded-case circuit breakers.
- Explain the steps involved in fuse replacement and/or circuit breaker reset.

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Electrical Safety and Protection

Lesson 7: Motor Protection

Topics

The Importance of Motor Protection; Motor-Feeder Protection; Feeder Size; Branch Circuits; Motor Branch-Circuit Overcurrent Protection; Motor-Running Overcurrent Protection; Inherent Thermal Protection; Temperature-Sensing Devices; Current-Sensing Devices; Melting-Alloy Relays; Bimetallic Relays; Selecting Motor Protection; Ambient-Compensated Overload Relays; Single Phasing; Protecting Overload Relays

Objectives

- List the steps in determining the correct rating of the motor feeder protection.
- Explain how to select a thermal overload relay.
- Explain how thermostatic, resistance, and thermocouple detectors work.
- Contrast temperature-sensing devices and current-sensing devices.
- Explain how various relays provide motor protection.
- Define single phasing.

Single-Phase Motors

Course 207: Single-Phase Motors

Covers the types and operating principles of common single-phase motors. Explains NEMA motor standards. Explains how to identify motor leads on split-phase, capacitor-start, capacitor-run, permanent split capacitor, and repulsion motors. Covers universal motors, shaded-pole motors, synchro motors, and servo systems. Gives general maintenance procedures on all single-phase motors. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Introduction to Single-Phase Motors

Topics

Parts of a Single-Phase Motor; Definitions; NEMA Motor Standards; Motor Enclosures; Nameplate Data; Induction Motors; Single-Phase Stator Field; Single-Phase Rotor Field; Split-Phase Starting; Number of Poles; Electrical Degrees; Synchronous Speed; Starting Switches; Standard and Special Split-Phase Motors

Objectives

- List the parts of a rotor.
- List the data given on a typical motor nameplate.
- Explain how an induction motor works.
- Demonstrate how to calculate the number of electrical degrees in one complete rotation of a motor.
- Explain how a centrifugal switch works.

Lesson 2: Split-Phase Motors

Topics

Starting Single-Phase Motors; Stator Windings; Split-Phase Motor Connections; Identifying Motor Leads; Winding Connections; Skein Winding; Consequent-Pole Windings; Two-Speed Motors; Two-Speed, Three-Winding Motors; Four-Winding Motors; Dual-Voltage Motors; Troubleshooting Split-Phase Motors; Open Circuit in a Winding; Shorted Turns in a Winding; When a Motor Fails to Start; When a Motor Runs Slow

Objectives

- State the reason why a second stator winding is important in the single-phase induction motor.
- Explain how to identify motor leads when there are no tags or colors to identify them.
- Describe a skein winding.
- List the ways to change the speed of a motor by changing the number of poles.
- Discuss some common motor problems.

Lesson 3: Capacitor Motors

Topics

Kinds of Capacitor Motors; The Capacitor; Capacitor-Start Motor Operation; Rotating Magnetic Fields; Single-Voltage Reversible Motors; Single-Voltage Three-Lead Motors; Instantly Reversible Motors; Dual-Voltage Motors; Capacitor-Start Capacitor-Run Motors; Permanent-Split Motors; Reversible Capacitor-Run Motors; Two-Speed Capacitor-Run Motors; Troubleshooting Capacitor Motors; Symptoms and Causes of Motor Trouble; Replacing Capacitors

Objectives

- State the definition of a capacitor.
- Explain how to make a split-phase motor operate as a capacitor-start motor.
- Explain how the running windings are connected to make a dual-voltage motor run on either 120 or 240 volts.
- Select the best capacitor to use as a substitute for a defective capacitor when an identical unit is not available.
- List problems that cause the circuit breaker to trip when you turn on a capacitor motor.

Lesson 4: Repulsion Motors

Topics

Characteristics of Repulsion Motors; Repulsion-Start, Induction-Run Motors; The Repulsion Principle; Hard and Soft Neutral Planes; Purpose of the Brushes; Short-Circuiter; Commutator; Brush-Lifting Mechanism; Brush-Riding Motor; Brush Holders; Hard Neutral Setting; Brush Replacement; Repulsion Motor; Compensated Repulsion Motor; Repulsion-Induction Motor; Stator and Armature Windings; Equalizer Connections; Troubleshooting and Maintenance

Objectives

- Discuss the operating principles of a repulsion-start induction-run motor.
- Explain how to seat new brushes on the commutator.
- Discuss the functions of the major motor components.
- List the reasons a repulsion motor might fail to start.

Lesson 5: Universal Motors

Topics

Operating a DC Shunt Motor on AC Power; DC Series Motors Operated on AC Power; Hysteresis and Eddy-Current Losses; Advantages of Universal Motors; Performance Characteristics; Speed Control; Motor Life; Universal Motor Assemblies; Ventilation; Brush Mountings; Brush Selection; Electrical Connections; Troubleshooting and Repair

Objectives

- Explain eddy current loss in the universal motor.
- List the advantages of a universal motor.
- Explain how the speed of the universal motor is controlled.
- List the criteria for selecting carbon brushes for universal motors.
- State reasons why a universal motor might have poor torque.

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Single-Phase Motors

Lesson 6: Special Motors

Topics

Shaded-Pole Motors; Principles of Operation; Reversing Shaded-Pole Motors; Synchronous Motors; Hysteresis Motor Construction; Theory of Hysteresis Motors; Unexcited Synchronous Motors; Inductor Motors; Reluctance Motors; Permanent-Magnet Motors

Objectives

- State the definition of a salient pole.
- Explain the operating principles of a shaded-pole motor.
- Discuss the operating principles of a hysteresis motor.
- Explain the difference between an unexcited synchronous motor and an excited synchronous motor.

Lesson 7: Synchros

Topics

A Synchro System; Rotor Construction; Stator Construction; Terminal-to-Terminal Stator Voltages; Synchro Assembly; Synchro Transmitter Operation; Receivers; A Simple Synchro System; Synchro Transmission Systems; Reversing a Receiver's Rotation; Differential Receivers and Transmitters; TX-TDX-TR Synchro Systems; Control Synchro Systems; The Control Transformer; CX-CT System

Objectives

- State the definition of the term synchro.
- Describe motor construction in a synchro.
- Demonstrate how to calculate terminal-to-terminal stator voltage.
- State the reason why the control transformer is important in a synchro control system.
- Explain how to connect a differential synchro system.

Lesson 8: Servos

Topics

Servomechanisms; Operation of a Basic Servomechanism; Amplidynes; Amplidyne Operation; Overtravel Control; DC Servomotors; AC Servomotors; Servocontrol Bridges; Servo Actuators

Objectives

- State the definition of a servomechanism.
- List the four characteristics needed to keep a regulated quantity matched to a reference valve in a servomechanism.
- Explain how an amplidyne control system works.
- Discuss how to control overtravel in a servomechanism.

Lesson 9: Motor Installation

Topics

Protecting Single-Phase Motors; Conductor Size; Preventing Shorts and Grounds; Single-Phase Motor Controllers; Overcurrent Protection; Disconnecting Devices; Guards and Grounding; Fuses; Selecting Fuses; Manual Single-Phase Starters; Integral-Horsepower Starters; Single-Phase Magnetic Starters; Selecting the Proper Motor; Service Factor; Classification of Insulation; Selecting Split-Phase Motors; Selecting Capacitor-Start Motors; Selecting Permanent Split-Capacitor Motors; Selecting Shaded-Pole Motors

Objectives

- Explain how to determine conductor size for motors.
- State the definition of a controller.
- List the conditions under which the frames of stationary motors must be grounded.
- Demonstrate how to determine the size of a dual-element when two or more motors are connected to one feeder.
- List the electrical and mechanical factors to consider in selecting a motor for a specific application.

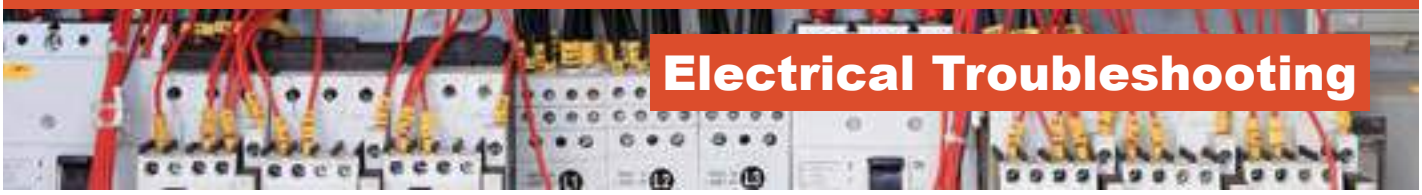
Lesson 10: Motor Maintenance

Topics

General Maintenance Procedures; Testing Capacitors; Armature Defects; Testing Stator Windings; Locating Problems in Motors; Noisy Operation; Bearing Problems; High Temperatures; Incorrect Speed; Excessive Sparking at the Brushes; Test Equipment

Objectives

- Demonstrate how to test bearings for wear.
- Explain how to test capacitors.
- State the reason why proper belt tension in important.
- List the common causes of excessive brush sparking.



Electrical Troubleshooting

Course 210: Electrical Troubleshooting

Covers use of schematic diagrams, determining sequence of operation, and use of building diagrams and single-line diagrams. Includes troubleshooting procedures for control circuits and combination starters. Explains troubleshooting practices on DC and AC motors, identifying unmarked leads on three-phase delta and Y-connected motors, and troubleshooting lighting systems. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Troubleshooting with Electrical Schematics

Topics

Standard Symbols and Diagram Identification; Elementary Diagrams; Reading the Schematic Diagram; Power Circuit; Control Circuit; Motor-Starting Circuit; Identifying Conductors; Numbering Components; Locating Relay Contacts; Control-Panel Layouts; Sequence of Operation; Related Schematic Information

Objectives

- Identify a control relay on an electrical schematic.
- State the NEC requirements for fuses in ungrounded conductors.
- Explain component numbering on electrical schematics.
- Explain how conductors in a motor-control circuit are identified.

Lesson 2: Troubleshooting with Building Drawings

Topics

Architectural Drawings; Materials for Construction; Installation Drawings and Diagrams; Riser Diagrams; Substation Drawings; One-Line Diagrams; Electrical Symbols on Blueprints; Building Lighting Diagrams; Power Installation Drawings; Circuit Tracing

Objectives

- Name the kinds of drawings used by electrical specialists.
- Identify electrical symbols commonly used for building diagrams.
- Describe a one-line diagram.
- Discuss the different types of drawing characteristics.

Lesson 3: Troubleshooting Control Circuits

Topics

Control-Circuit Functions; Trouble Conditions; Conditions of Protection; Pushbutton Control Circuits; Sequence-Control Circuits; Troubleshooting Control Circuits; Overload-Protection Circuits; Troubleshooting a Motor Circuit

Objectives

- Explain how severe three-phase voltage unbalance affects a three-phase motor.
- List the advantages of inherent protection.
- Explain how undervoltage release works.
- Describe how to troubleshoot a motor circuit.

Lesson 4: Troubleshooting Combination Starters

Topics

Troubleshooting Control Circuits; Instruments for Troubleshooting; Troubleshooting a Starter; Step-by-Step Troubleshooting Procedures; Troubleshooting Problems; Steps in Locating Problems; Troubleshooting Control Relays; Using Relay-Troubleshooting Charts; Latching-Relay Contact Checks; Timing-Relay Checks; Replacing Relay Coils

Objectives

- List the reasons why a magnet coil burns or short-circuits.
- List the steps in troubleshooting a defective motor.
- Explain how a mechanical latching relay works.
- Explain how an electronic timing relay operates.

Lesson 5: Troubleshooting Control Devices

Topics

Reversing Controllers; Using a Checking-Sequence Chart; Autotransformer Starters; Multispeed Motor-Starter Controls

Objectives

- Demonstrate how to reverse the rotation of a three-phase induction motor.
- Explain the function of limit switches in reversing-motor applications.
- Describe how to use a checking-sequence chart.
- Select the best starter for use where it is undesirable to put a heavy load on the power supply.
- Explain how to change the speed of a squirrel-cage motor.

Lesson 6: Troubleshooting Special Controls

Topics

Selenium Rectifiers; Unbalance in Three-Phase Rectifiers; Selenium-Rectifier Life; Testing Rectifier Diodes; Testing Three-Phase Rectifiers; Electric-Pneumatic Control Circuits; Speed, Size and Safety Comparisons; Comparing Relays and Valves; Control-System Logic; Producing Memory with Feedback; Static Control and Logic; Logic Functions; Time-Delay Element

Objectives

- Explain the effects of age on a selenium rectifier.
- Name the protective devices used in electrical systems and pneumatic systems.
- State the definition of a bistable device.
- List the functions of a static control device.

Lesson 7: Troubleshooting DC Motors

Topics

Problems in DC Motors; Commutator Discoloration; Brush Sparking; Open Armature Winding; Electrical Vibration; Mechanical Vibration; Stationary Parts of the Motor; Brush Problems; Bearings; DC Motor Controls; Drum Controllers; Problems Caused by Fire and Flood

Objectives

- List causes of electrical and mechanical vibration in a dc motor.
- Explain how oil saturation affects brushes in a dc motor.
- Explain how maximum bearing operating temperature is determined.
- List problems in the motor control that can cause sudden or unexpected changes in motor speed.
- Explain how to salvage a water-soaked motor.

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Electrical Troubleshooting

Lesson 8: Troubleshooting AC Motors

Topics

Failures in Three-Phase Motors; Grounded Stator Windings; Shorted Pole-Phase Groups; Reversed Pole-Phase Groups; Short-Circuited Phases; Reversed Phases; Open Circuits; Incorrect Voltage Connections; Identifying Y Connections; Identifying Delta Connections; Troubleshooting Split-Phase Motors; Grounded Windings; Open Circuits in Split-Phase Motors; Short-Circuited Windings; Noisy Operation

Objectives

- Identify various kinds of three-phase motor failures.
- Demonstrate how to conduct a balanced-current test on a three-phase, Y-connected winding.
- List the symptoms of a reversed phase in a three-phase winding.
- Explain how to identify external leads that have become defaced.
- Demonstrate how to test for an open circuit in a split-phase motor.

Lesson 9: Troubleshooting Lighting Systems

Topics

Planned Lighting Maintenance; Troubleshooting Basics; Troubleshooting Fluorescent Lighting Systems; Troubleshooting Dimmable Fluorescent Lighting Systems; Troubleshooting HID Lighting Systems; Troubleshooting Dimmable HID Lighting Systems; Troubleshooting Incandescent Lamps; Troubleshooting Occupancy Sensors and Other Switching Controls

Objectives

- Describe the elements of a planned maintenance program.
- Explain the function of lamps, ballasts, and lighting controls.
- Describe the basic troubleshooting process.
- Detail how to troubleshoot common lamp ballast system problems.
- Describe lighting system commissioning.
- Detail how to troubleshoot common occupancy sensor and dimming system problems.

Lesson 10: Saving Time in Troubleshooting

Topics

Preliminary checks; Analyzing the complaint; Checking refrigerant pressures; Sequence of Operation; Developing the Graph and Log; Tracing Circuit Problems; Troubleshooting Before Installation; Troubleshooting After Installation; Standardizing Prints; Equipment Changes and Modifications; Motor-Location File

Objectives

- Name and describe the elements of a sequence of operation.
- List the features that must appear on an elementary wiring diagram to make it comply with JIC standards.
- List the steps in troubleshooting a new machine.
- List the information to be included in a motor location file.
- Select the best method for identifying a motor.

Basic Mechanics

Course 301: Basic Mechanics

Covers force, motion, work, energy, and fluid mechanics as applied in industrial maintenance. Explains principles of operation for simple machines. Explains the basic elements of industrial machines, as well as common measurement tools used to monitor and adjust equipment. Covers hand tools, power tools and fasteners, ending with a discussion of ways to reduce friction and wear. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Forces and Motion

Topics

Definition of Force; Sources of Forces; Measuring Forces; Forces Applied to Stationary Objects; Normal Forces; Describing Motion; Acceleration; Types of Motion; Newton's Law of Motion

Objectives

- Name five ways forces originate.
- Explain how forces are measured.
- Define velocity, acceleration, and elastic distortion.
- Define rotary motion and reciprocating motion.
- State and explain Newton's Laws of Motion

Lesson 2: Work, Energy, and Power

Topics

Defining Work; Measuring Work; Torque; Energy; The Law of Conservation of Energy; Forms of Energy; Kinetic and Potential Energy; Power; Horsepower; Calories and Btu

Objectives

- Define work, and explain how to calculate it.
- Define the terms torque and prime mover.
- Define energy, and tell how it is measured.
- Differentiate between kinetic and potential energy, and give an example of each one.
- Define power and horsepower, and tell how each is measured.

Lesson 3: Fluid Mechanics

Topics

Definition of a Fluid; Fluids Distribute Forces; Definition of Pressure; Measuring Pressure; Sources of Fluid Pressure; Gauge Versus Absolute Pressure; Liquid Seeks Its Own Level; Velocity Head Versus Static Pressure Head; The Bernoulli Effect; Venturi Applications; Friction Head; The Siphon

Objectives

- Define a fluid.
- Define pressure, and identify common units of pressure measurement.
- State Pascal's Law, and give an example of its application.
- Explain the difference between gauge pressure and absolute pressure.
- Explain the Bernoulli Effect, and give three examples of how it is utilized in industry.
- Explain how a siphon works.

Lesson 4: Simple Machines

Topics

Simple Machines in Your Life; The Lever; Classes of Lever; The Wheel and Axle; Gear Trains; The Inclined Plane; The Wedge; Cam-and-Follower Devices; The Screw; Jackscrews; Pulleys and Pulley Systems; Mechanical Efficiency

Objectives

- Identify and name six types of simple machines.
- Calculate the ideal mechanical advantage of each of six simple machines.
- Describe the action and purpose of cam-and-follower mechanisms.
- Determine the ideal mechanical advantage of several simple gear trains.
- Explain mechanical efficiency and show how to calculate it.

Lesson 5: Machine Elements

Topics

The Machine; Machine Motions; Mechanisms; Lever Linkages; Four-Bar Linkages; Cam-and-Follower Mechanisms; Devices For Producing Linear Motion; Ratchet-and-Pawl Mechanisms; Fluid-Powered Mechanisms; Applying Your Knowledge of Mechanisms

Objectives

- List the four classifications of mechanisms.
- Name the six basic motion conversions, and give an example of each.
- Explain the functions of bell cranks, Pitman arms, and toggle bars.
- Name three types of four-bar linkages, and explain how they function.
- Describe the ratchet-and-pawl mechanism.

Lesson 6: Measurement Tools and Instruments

Topics

Definition of Measurement; Measurement Terminology; Function of Measurement Tools and Instruments; Classification of Measurement Instruments; Typical Portable Instrument Design; Measurements in Maintenance; Routine Maintenance and Repair; Process Monitoring and Quality Assurance; Predictive Maintenance

Objectives

- Define measurement, parameter, accuracy, precision, sensitivity, and range.
- Explain why measurements are important to maintenance operations.
- Describe the general features of a portable measurement instrument.
- List the basic measurement instruments most often used in mechanical maintenance, and describe the operating principles of each.

Basic Mechanics

Lesson 7: The Safe Use of Hand Tools

Topics

Screwdrivers; Wrenches; Hammers and Mallets; Chisels and Punches; Saws; Files and Rasps; Snips, Nippers, and Cutters; Pliers; Organizing Your Tools

Objectives

- Name the major hand tools used in maintenance.
- State criteria for selecting the proper tools for specific jobs.
- Identify safe/unsafe practices in the use of hand tools and explain why they are safe/unsafe.
- Explain how to prolong the useful life of selected hand tools.
- Explain the advantages of having a well-organized tool box.

Lesson 8: The Safe Use of Portable Power Tools

Topics

Hazards of Power Tool Use; Rules to Observe Before Using Power Tools; Protection Against Electric Shock; Electric Drills; Electric Sanders; Portable Grinders; Portable Circular Saws; Saber Saws; Metal Shears; Electric Impact Wrenches; Rotary Hammers; Pneumatic Power Tool Safety; Pneumatic Impact Wrenches; Pneumatic Hammers; General Guidelines for Power Tools

Objectives

- State three precautions to take before using any power tool.
- Describe the safe use of each of the following power tools: electric drills, sanders, grinders, and saws; electric impact tools; pneumatic impact wrenches and hammers.
- State three general guidelines for the safe operation of any portable power tool.
- Describe the potential electrical hazards associated with electric power tools.

Lesson 9: Fasteners

Topics

Kinds of Threaded Fasteners; Screw Threads; Screw Thread Specifications; Threaded Fastener Specifications; Types of Nuts; Washers; Safety Wiring; Keys and Pins; Rivets

Objectives

- Identify seven major types of threaded fasteners.
- Read and interpret common screw thread and threaded fastener specifications.
- Describe the three actions in a manual riveting operation, and explain why each action must be done properly.
- Demonstrate the proper technique for safety wiring a group of threaded fasteners.
- Identify three kinds of washers.

Lesson 10: Friction and Wear

Topics

The Nature of Friction and Its Importance; Causes of Friction; Static and Kinetic Friction; Measuring Friction; Coefficients of Friction; Wear—The Major Consequence of Friction; Static Electricity

Objectives

- Define friction, identify the forces that cause it, and describe its effects.
- Differentiate between static friction and kinetic friction.
- Define coefficient of friction.
- Calculate the expected friction force between two surfaces, given the normal force and the coefficient of friction.
- Describe four types of wear.

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Lubricants and Lubrication

Course 302: Lubricants and Lubrication

Covers a complete lubrication training program, including functions and characteristics of lubricants, factors in selection of lubricants, and effects of additives. Oils, greases, and other compounds used for lubrication are described, as well as their applications. Lubrication methods and recommended storage and handling procedures are included. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Principles of Lubrication

Topics

Lubrication; Lubricant Classification; Characteristics of Friction; Why Lubricate Machinery?; Reducing Wear; Dampening Shock; Cooling Action of Lubricants; Corrosion Prevention; Sealing Action of Lubricants; Preventive Maintenance

Objectives

- Define lubrication and describe the four forms of lubricants.
- Discuss the characteristics of static, kinetic, fluid, and rolling friction.
- Explain how a lubricant reduces wear and dampens shock.
- Discuss the cooling action of lubricants and explain how they prevent corrosion.
- Explain the importance of a lubricant's sealing action, and explain how it works.

Lesson 2: Lubricant Characteristics

Topics

Types of Lubricants; Sources of Petroleum; Refining Petroleum; Finish Processing of Lubricants; Chemistry of Petroleum; Properties of Lubricating Oils; Viscosity; Viscosity Index; Flash Point and Fire Point; Pour Point; Oxidation Resistance; Emulsification; Greases; Lubricant Selection

Objectives

- Describe how lubricating oils are obtained and processed and briefly discuss the chemistry of petroleum.
- Explain how viscosity is rated and measured in lubricating oils.
- Explain how flash point, fire point, pour point, oxidation resistance, and emulsification affect a lubricant.
- Describe the five major properties of greases.
- Name four factors that affect lubricant selection.

Lesson 3: Additives, Lubricating Action, and Bearing Lubrication

Topics

The Nature of Additives; Multipurpose Lubricants; Bearing Lubrication; Problems in Bearing Lubrication

Objectives

- Describe the nature and purpose of pour-point depressants, oxidation inhibitors, viscosity-index improvers, and antifoam agents.
- Explain how rust and corrosion inhibitors, extreme-pressure additives, and detergent-dispersants work.
- Discuss the use of emulsifying and demulsifying agents, oiliness and antiwear agents, tackiness agents, and other additives.
- Describe the differences between mixed-film, boundary, and full-film lubrication.
- Discuss elements which determine proper bearing lubricant selection.
- Identify common bearing lubrication problems and ways to avoid them.

Lesson 4: Oils and Their Applications

Topics

General-Purpose and Special-Purpose Oils; Oil Bases; Equipment; Types of Lubricating Oils; Circulating Oils; Gear Oils; Machine Oils; Spindle Oils; Refrigeration Oils; Steam Cylinder Oils; Internal Combustion Engine Oils; Lubricating Wire Ropes

Objectives

- Describe the four types of oil bases.
- Name three types of circulating oils and describe their properties.
- Compare the characteristics and uses of gear oils, machine oils, and spindle oils.
- Discuss the special properties of refrigeration oils, steam cylinder oils, and internal combustion engine oils.

Lesson 5: General-Purpose Greases

Topics

Why Grease?; Grease Defined; How Greases Are Made; Characteristics of Greases; Classification of Greases; Calcium-Soap Greases; Sodium-Soap Greases; Barium-Soap Greases; Lithium-Soap Greases; Aluminum-Soap Greases; Other Soap-Based Greases; Nonsoap-Based Greases; Guidelines for Grease Selection; Bearing Relubrication Techniques; General Do's and Don'ts

Objectives

- Define grease and compare the advantages of using greases and using oils.
- Describe methods for making grease and compare the uses and properties of at least five soap-based greases.
- State the advantages and disadvantages of using nonsoap-based greases.
- Discuss grease selection and application for plain and antifriction bearings.

Lesson 6: Special-Purpose Greases and Dry-Film Lubricants

Topics

Multipurpose Greases; Additives; Extreme-Pressure Greases; Water-Repellent Greases; High- and Low-Temperature Greases; Lamellar Greases; Silicone Greases; Dry-Film Lubricants; Dry-Film Lubricant Application

Objectives

- List three purposes for grease additives and explain how extreme-pressure greases accomplish their purpose.
- Compare uses and characteristics of water-repellent and high- and low-temperature greases.
- Describe lamellar greases, giving an example, and list some special uses for silicone greases.
- Compare three types of dry-film lubricants and describe how and where to use them

Lubricants and Lubrication

Lesson 7: Lubrication Systems and Methods

Topics

Selecting a Lubrication System; Lubricating Methods; Manual Lubrication; Gravity Lubrication; Natural Lubrication; Pressure Lubrication

Objectives

- Name four main considerations for selecting a lubrication system and explain the importance of each.
- Explain how manual and drip lubrication methods work.
- Describe the operating principles of natural and pressure lubrication methods.

Lesson 8: Automatic Lubrication Methods

Topics

Automatic Lubrication; Oil Lubrication; Sight-Glass Flow Indicators; Spray Nozzles and Valves; Metered Systems; Header Systems; Single-Line Metering; Two-Line Metering; Progressive Metering

Objectives

- Describe a typical positive feed oil lubrication system.
- Compare three types of sight glass flow indicators.
- Describe types and operation of various spray nozzles and valves used in automatic lubrication systems.
- Compare the operation of header and progressive metering systems.

Lesson 9: Lubricant Storage and Handling

Topics

Importance of Proper Storage; Inside Storage; Outside Storage; Drum and Tank Dispensing; Direct Dispensing; Inventory and Rotating Stock; Purification and Reclamation; Gravity Separation; Centrifuges; Strainers; Absorbent Filters

Objectives

- Explain the importance of proper lubricant storage and describe good inside and outside storage practices.
- Describe various methods of dispensing lubricants.
- Discuss proper inventory and stock rotation procedures and define lubricant purification and reclamation.
- Explain how gravity separation, centrifuges, strainers, and filters work.

Lesson 10: Lubrication Management

Topics

Good Lubrication Practices; Manual Systems of Lubrication Control; Establishing Oiler Routes; Color-Coding the Lubrication Points; Computer-Managed Lubrication Programs; Installing the System; Useful Computer Reports; Expanded Programs; Making the System Work

Objectives

- Explain the importance of good lubrication management practices and describe seven different kinds of information that should be included on an equipment lubrication survey form.
- Explain how to set up an oiler route and how to color-code the lubrication points.
- Discuss the considerations involved in establishing and installing a computerized lubrication program.
- Describe the purposes of several types of basic computer lubrication forms and list advantages of expanded programs.

Bearings

Course 304: Bearings

Covers principles and applications of various types of bearings, including plain journal, ball, and roller bearings. Explains installation, inspection and repair of bearings. Deals with specialized bearings, including powdered-metal, nonmetallic, and hydrostatic bearings. Covers bearing seals, lubrication, and maintenance practices. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Bearings and Shafts

Topics

Bearing Classification; Bearing Selection; Principles of Bearing Operation; Shafts and Shafting; Shaft Materials; Shaft Stresses; Vibration and Critical Speed; Fits and Clearances

Objectives

- Name the two main categories of bearings and cite their advantages.
- Identify bearings by the kind of support they provide.
- Describe the three kinds of stresses acting on shafts.
- Explain natural frequency of vibration and critical speed.
- Name and describe three classes of fits.

Lesson 2: Plain Journal Bearings I

Topics

Plain Journal Bearings; Advantages of Plain Journal Bearings; Lubrication; Lubricating Grooves; Seals; Types of Plain Journal Bearings; Split Bearings; Bearing Design and Selection

Objectives

- Explain the function of lubricating grooves.
- State two reasons for using seals on plain bearings.
- Name the principal types of plain journal bearings.
- Describe the structure of two kinds of precision inserts.
- Define crush and spread.

Lesson 3: Plain Journal Bearings II

Topics

Characteristics of Bearing Materials; Score Resistance; Load Capacity; Fatigue Strength; Conformability; Embeddability; Corrosion Resistance; Temperature Resistance; Bearing Materials; Inspection; Bearing Repair; Relining; Disassembly and Reconditioning; Bearing Installation

Objectives

- Name and explain the characteristics that are most important in materials for bearings.
- State advantages and disadvantages of the standard types of bearing materials.
- Describe standard practices for inspecting bearings.
- Explain bearing repair procedures.

Lesson 4: Antifriction Bearings I

Topics

Antifriction Bearings; Operating Principles; Bearing Materials; Cage Materials; Lubrication of Antifriction Bearings; Seals and Shields; Bearing Classifications; Tolerances; Bearing Installation

Objectives

- Identify the functions of the various parts of a typical rolling-element bearing.
- Explain the three elements of the AFBMA code.
- Define the categories of tolerances for ball bearings.
- Describe the factors that influence running accuracy of bearings.

Lesson 5: Antifriction Bearings II

Topics

Bearing Design; Environment; Mounting Types; Radial and Axial Clearance; Fixed and Floating Bearings; Bearing Fits; Squareness and Alignment; Mounting Methods; Mounting for Precision Applications; Bearing Applications

Objectives

- Name the factors that must be considered in the design of antifriction bearings.
- Describe the process of checking adequate running clearances for bearings.
- Explain the reasons for using fixed and floating bearings together.
- Describe the common methods of mounting bearings.

Lesson 6: Ball and Roller Bearings

Topics

Ball and Roller Bearings; Ball Bearings; Basic Ball Bearings; Single-Row, Angular-Contact Bearings; Double-Row, Angular-Contract Bearings; Other Ball Bearings; Two-Piece, Inner-Ring Bearings; Fractured-Ring Bearings; Bearing Series; Roller Bearings; Cylindrical Roller Bearings; Spherical Roller Bearings; Tapered Roller Bearings; Needle Roller Bearings

Objectives

- Name the three basic ball bearing designs and describe their characteristics.
- Explain the purposes served by the basic roller bearing shapes and their variations in typical applications.

Lesson 7: Specialized Bearings

Topics

Thrust Bearings; Self-Aligning Bearings; Linear-Motion Bearings; Mounted Bearings; Instrument Bearings; Unground Ball Bearings; Powdered-Metal Bearings; Nonmetallic Bearings; Other Materials; Hydrostatic Bearings

Objectives

- Identify ten specialized bearings.
- Describe a specific function or application of each of these bearing types.

Lesson 8: Bearing Seals

Topics

Why Seals Are Used; Seal Functions; Labyrinth Seals; Oil Seals; Oil Seal Terminology; Oil Seal Classification; Special Seals; Seal Selection; Other Seal Materials; Seal Applications; Other Special Seals; O-Rings and Mechanical Seals

Objectives

- Identify the functions of bearing seals.
- Describe the construction and operation of labyrinth and oil seals.
- Explain the two classification systems for oil seals.
- Name typical applications for the different kinds of seals.

Bearings

Lesson 9: Lubrication

Topics

Lubrication Practices; Bearing Lubrication and Lubricants; Oil Lubrication; Grease Lubrication; Special-Purpose Greases; Packing Bearings; Lubrication Equipment; Manual Lubricating Devices; Natural Oil Lubrication Systems; Pressurized Oil Lubrication; Automatic Oil Lubricating Devices; Automatic Grease Lubrication Systems; Rules for Lubrication

Objectives

- State typical applications for oil lubrication of bearings.
- Detail the cleaning procedures for different oil lubrication systems.
- Discuss the three qualities that are the bases for selecting a grease lubricant.
- Give five easy rules for lubricating bearings.

Lesson 10: Bearing Maintenance

Topics

Bearing Maintenance; Installing Plain Journal Bearings; Installing Antifriction Bearings; Mounting a Bearing; Bearing Removal; Bearing Loading Patterns; Bearing Failure Terminology; Bearing Cleaning

Objectives

- Identify a principal cause of early bearing failure.
- Describe installation procedures for antifriction and plain journal bearings.
- Name the different types of bearing failure and their causes.
- Tell how bearings should be cleaned and lubricated after inspection.

Pumps

Course 305: Pumps

Covers typical applications of various types of pumps. Describes factors affecting pump selection. Explains operating principles of centrifugal, propeller, and turbine, rotary, reciprocating, and metering pumps. Includes special-purpose pumps, diaphragm pumps, and others designed to handle corrosive and abrasive substances. Covers pump maintenance, packing gland, seal, and bearing replacement. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Pump Development and Application

Topics

The Development of Pumps; Pumping Systems; Water Pumping Systems; Chemical Pumping Systems; Waste Pumping Systems; High-Viscosity Material Pumping Systems; Solids Pumping Systems

Objectives

- Describe dead-end and recirculating hot water distribution systems.
- List several special considerations involved in chemical pumping systems.
- Define the term viscosity and give examples of high-viscosity materials.
- Tell the effects of heat on the pumping of high-viscosity materials.
- List some special problems involved in the pumping of solids.

Lesson 2: Basic Pump Hydraulics

Topics

Pumping Terminology; Calculating Total Head; Horsepower Calculations; Total Energy vs. Available NPSH; Available NPSH vs. Required NPSH; Pump Performance Curves; Head Capacity Curves; Efficiency Curves; Horsepower Curves; Curve Families; Pump Selection

Objectives

- Describe suction head and suction lift pumping conditions.
- Tell what three elements make up total dynamic head.
- Define static suction head.
- Contrast liquid, brake, and electrical horsepower.
- Tell what useful information can be gained from pump curves.

Lesson 3: End-Suction Centrifugal Pumps

Topics

Introduction to Centrifugal Pumps; Pump Operation; Pump Part Definitions; Pump Casing Materials; End-Suction Casing Configurations; Split-Case Centrifugal Pumps; Double-Volute Pumps; Impeller Types; Wearing Rings; Shafts, Bearings, and Sleeves

Objectives

- Describe the function of the following: pump casing, shaft, impeller, wearing rings, and stuffing box.
- Contrast frame-mounted and close-coupled end-suction pumps.
- Give characteristics of fluids pumped with open, semi-open, and closed impellers.
- Name an advantage and a disadvantage each for stainless steel and brass shaft sleeves.

Lesson 4: Propeller and Turbine Pumps

Topics

Turbine Pump Introduction; Lineshaft Turbines' Submersible Turbines; Flow Patterns; Axial-Flow Propeller Pumps; Mixed-Flow Propeller Pumps; Special Propeller Pumps; Turbine Pump Construction; Vertical Turbine Pump Applications; Regenerative Turbine Pumps

Objectives

- Explain the construction of a line-shaft turbine pump.
- Name the two types of flow possible in a propeller pump.
- Tell the function of diffuser vanes in an axial-flow propeller pump.
- Define electrochemical corrosion and state its cause.
- Describe fluids that can be pumped by a regenerative turbine pump.

Lesson 5: Rotary Pumps

Topics

Introduction to Rotary Pumps; External-Gear Pumps; Internal-Gear Pumps; Lobe Pumps; Screw Pumps; Vane Pumps; Rotary Piston Pumps; Flexible-Member Pumps; Rotary Pump Installations

Objectives

- Describe the fluids that can be pumped by a rotary pump.
- Explain the operation of external- and internal-gear pumps.
- Describe the parts and construction of a lobe pump.
- Compare and contrast timed and untimed screw pumps.
- Tell why sealed bearings might be used in a vane pump.

Lesson 6: Reciprocating Pumps

Topics

Reciprocating Pump Applications, Parts and Classifications; Steam-Driven Pump Operation; The Fluid End; The Steam End; Power Pump Operations; Horizontal and Vertical Plunger Pumps; Flexible-Member Pumps; Rotary Pump Installations

Objectives

- Name the parts that make up the power end of a reciprocating pump and describe their operation.
- Define the terms single-acting pump and double-acting pump.
- Compare simplex and duplex pumps.
- Explain how the pumped fluid lubricates a reciprocating pump.
- Calculate the discharge pressure of an air-driven pump when given the piston ration and motor air supply.

Pumps

Lesson 7: Metering Pumps

Topics

Introduction to Metering Pumps; Metering Pump Classifications; Plunger and Piston Metering Pumps; Diaphragm Pumps; Air-Operated Metering Pumps; Rotary Metering Pumps

Objectives

- Tell what kinds of pumps are used for metering applications.
- Describe metering pump lubrication techniques.
- Name the parts of a diagram metering pump and state the function of each.
- Explain the operation of a diaphragm metering pump.

Lesson 8: Special-Purpose Pumps

Topics

Handling Difficult Materials; Chemical Pumps; Special Chemical Pumps; Magnetic-Drive Pumps; Canned-Motor Pumps; Centrifugal Slurry Pumps; Pulp-Handling Pumps; Trash and Sewage Pumps; Diaphragm Pumps; Reciprocating Slurry Pumps; Vortex Pumps

Objectives

- Describe the operation of a flexible-tube pump.
- Give an application for a progressing-cavity pump.
- Name one disadvantage of a seal-less magnetic-drive pump.
- Explain how to prepare a new centrifugal pump for operation.
- Tell which parts of a reciprocating slurry pump require the most maintenance.

Lesson 9: Packings and Seals

Topics

Pump Sealing Requirements; Stuffing Boxes; Types of Stuffing Boxes; Packing Materials; Installing Packing; Mechanical Seals; Special Seals

Objectives

- Tell why slight leakage through shaft seals is necessary.
- Name the type of stuffing box required for pumps operating under suction lift conditions.
- Give a typical application each for cotton, Teflon®, and aluminum packing.
- Describe the procedure involved in replacing pump packing.
- Describe a packingless seal.

Lesson 10: Pump Maintenance

Topics

Pump Bearings; Sleeve Bearings; Antifriction Bearings; Special Bearings; Bearing Lubrication; Bearing Seals; Pump Installation; Pump Maintenance; End-Suction Centrifugal Pumps; Vertical Turbine Pumps; Rotary Pumps; Reciprocating Pumps; Difficult Material Pumps; Other Maintenance Problems

Objectives

- Name three types of antifriction bearings.
- Name three factors to consider when preparing pump lubrication schedules.
- Describe a typical application for each of the following bearing seals: felt, leather, synthetic.
- Tell the two major maintenance problems encountered in rotary pumps.
- Explain how to identify worn piston rings in a reciprocating pump.

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Basic Hydraulics

Course 307: Basic Hydraulics

Covers hydraulic principles, types of hydraulic fluids and their characteristics. Describes components of the hydraulic system and their functions, including filters and strainers, reservoirs and accumulators, pumps, piping, tubing and hoses, control valves, relief valves, and actuating devices. Covers a variety of cylinders and hydraulic motors. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Principles of Hydraulics

Topics

Fluid Power and Hydraulics; Force, Weight, and Mass; Pressure; Work, Power, and Energy; Incompressibility and Nondiffusion; Hydrostatic Pressure; Pascal's Law; Transmission of Fluid Power; Fluid Flow in Pipes; Bernoulli's Principle; The Effect of Heat on Liquids; Hydraulic Power Systems

Objectives

- Explain the difference between absolute and gauge pressure.
- Demonstrate how power is calculated.
- Explain Pascal's Law.
- Describe the difference between laminar and turbulent flow.
- Name the main components of a hydraulic system.

Lesson 2: Hydraulic Fluids

Topics

Functions of Hydraulic Fluids; Physical Properties; Viscosity; Viscosity Index; Viscosity and Pressure; Pour Point; Fluid Selection; Component Protection; Chemical Properties; System Contamination; Water; Dissolved Air; Foaming; Corrosion and Rusting; Types of Hydraulic Fluids

Objectives

- List the most important properties of hydraulic fluids.
- Explain how viscosity is measured.
- Explain the meaning of the viscosity index.
- Describe the effect of fluid temperature on viscosity.
- Name the causes of corrosion and fluid oxidation.
- Identify various types of hydraulic fluids.

Lesson 3: Strainers and Filters

Topics

Hydraulic System Requirements; Settling; Degree of Filtration; Performance Characteristics; Performance of Different Media; Strainers; Reservoir Strainers; In-Line Strainers; Filters; Fiber Media; Nonfibrous Surface Media; Magnetic Media; Filter and Strainer Installations

Objectives

- Name contaminants found in hydraulic systems.
- Explain the difference between a strainer and a filter, and describe the main function of each.
- Describe the two basic types of filter/strainer media.
- Draw graphic symbols for strainers and filters.

Lesson 4: Reservoirs and Accumulators

Topics

System Demands; Fluid Reservoir Requirements; Baffles; Air Separation; Reservoir Cooling; Reservoir Accessories; Accumulators

Objectives

- Explain the functions of fluid reservoirs.
- Explain the purpose of reservoir baffles.
- Describe various methods of counteracting high operating temperatures.
- Identify important accessories used with reservoirs.
- Demonstrate pressure ratio calculation for a differential-piston accumulator.

Lesson 5: Hydraulic Pumps

Topics

Pump Classification; Rating and Selecting Factors; Capacity; Pressure; Energy Consumption; Drive Speed; Efficiency; Reliability; Fluid Characteristics; Size and Weight; Control Adaptability; Service Life; Installation and Maintenance Costs; Types of Pumps; Gear Pumps; External Gear Pumps; Internal Gear Pumps; Axial-Flow (Screw) Pumps; Cycloidal Pumps; Vane Pumps; Piston Pumps

Objectives

- Name the main classification of hydraulic pumps.
- List factors affecting pump selection and pump performance.
- Define volumetric efficiency and overall efficiency.
- Identify the most common types of positive-displacement pumps, and describe their operation.

Lesson 6: Piping, Tubing, and Fittings

Topics

Hydraulic Piping; Flow and Velocity; Hydraulic Pressure; Pressure Loss; Losses in a Line; Steel Pipe; Pipe Fittings; Pipe Installation; Tubing; Tube Bending; Tube Fittings; Hoses; Hose-End Fittings; Quick-Connect/ Disconnect Couplings; Hose Installations

Objectives

- Discuss the chief considerations in hydraulic line selection.
- Demonstrate how flow velocity and pressure loss are calculated.
- Explain pipe size schedules.
- Describe various types of fittings used in hydraulic systems.
- Explain the reason for using steel pipe.
- List the main advantages of tubing.

Basic Hydraulics

Lesson 7: Directional Control Valves

Topics

Directional-Control Valves; Manually Operated Valves; Automatic Two-Way Valves; Check Valves; Pilot-Operated Check Valves; Spool Valves; Two-Way Spool Valves; Hydraulic-Motor Control; Normally Open and Closed Valves; Holding Valves; Four-Way and Five-Way Valves; Rotary Valves; Valve Actuators; Flow Ratings; Accessories

Objectives

- Explain the classification of directional control valves.
- Describe how manually operated valves work.
- Explain the difference between direct-acting and pilot-operated valves.
- Describe the operation of a check valve, a spool valve, a three-way valve, a four-way valve, and a rotary valve.
- Explain the difference between normally closed and normally open valves.

Lesson 8: Pressure-Control Valves

Topics

Pressure-Control Valves; Pressure-Relief Valves; Poppet Valves; Spool Valves; Sequence Valves; Counterbalance Valves; Holding Valves; Unloading Valves; Pressure-Reducing Valves; Shock Suppressors; Flow-Control Valves; Pressure and Temperature Compensation

Objectives

- Explain the functions of a pressure-control valve, a pressure-relief valve, and a pressure-reducing valve.
- Describe the operation of a spool valve, a poppet valve, and a sequence valve.
- Explain the purpose of holding valves, unloading valves, and counterbalance valves.
- Name the operations performed by flow-control valves.
- Describe how pressure compensation and temperature compensation work.

Lesson 9: Cylinders

Topics

Description of Cylinders; Double-Acting Cylinders; Single-Acting Cylinders; Two-Piston Cylinders; Positional Cylinders; Cylinder Construction; Piston Rings and Seals; Rod Packings; Cylinder Mounting; Selecting a Cylinder; Flow Capacity; Cushioning; Piston Rod Strength; Cylinder Applications

Objectives

- Describe the purpose of a hydraulic cylinder, and explain how a double-acting cylinder works.
- Explain the difference between “pull-type” and “push-type” single-acting cylinders.
- Describe the construction of a hydraulic cylinder.
- Explain the various methods of mounting cylinders.
- Demonstrate how to calculate the flow capacity of a hydraulic cylinder.

Lesson 10: Hydraulic Motors

Topics

Motor Classification; Rating and Selection Factors; Hydraulic-Motor Construction; Gear, Vane, and Piston Motors; Rotary Actuators

Objectives

- Explain the classification of hydraulic motors.
- Demonstrate how the torque of a hydraulic motor is calculated.
- Calculate the horsepower output of a hydraulic motor.
- Discuss cost factors and other considerations affecting motor selection.
- Describe the construction of a hydraulic motor.
- Explain the operating principles of a gear motor, a vane motor, and a piston motor.

Basic Pneumatics

Course 309: Basic Pneumatics

Covers how work, force, and energy are applied to principles of pneumatics. Shows operating principles of reciprocating, positive displacement, rotary, and dynamic air compressors. Covers primary and secondary air treatment. Includes valves, logic devices, cylinders, and air motors. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Pneumatic Principles

Topics

Fluid Power Systems; Pneumatic Systems; Force, Weight, and Mass; Pressure; Work and Energy; Diffusion and Dispersion; Separation of Gases and Liquids; Compressibility; Laws of Pneumatics; Transmission of Pneumatic Fluid Power; Pneumatic Leverage; Air Properties; Air Flow in Pipes; Viscosity of Air; Bernoulli's Law; Components of Pneumatic Power Systems

Objectives

- Explain how force is transmitted in a pneumatic system.
- Calculate force and work.
- List two factors that affect the results of pressure calculations.
- Explain pneumatic leverage.
- Briefly explain the physical laws affecting the behavior of a confined gas.

Lesson 2: Reciprocating Compressors

Topics

Compressor Operation; Compressor Classification; Positive-Displacement Compressors; Reciprocating Compressor Operation; Single- and Double-Acting Compressors; Compressor Construction; Horsepower Cooling Requirements; Compressor Lubrication; Nonlubricated Compressors; Compressor Controls; Compressor Accessories; Advantages of Reciprocating Compressors

Objectives

- Differentiate between a positive-displacement compressor and a dynamic compressor.
- Describe the operation of a reciprocating compressor.
- List one advantage of using a multistage compressor.
- Identify the cooling arrangements for reciprocating compressors.
- Compare the operation of compressor controls in large and small units.

Lesson 3: Rotary Compressors

Topics

Compressor Classification; Vane Compressors; Rotary-Screw Compressors; Low-Pressure High-Volume Compressors; Diaphragm Compressors; Dynamic Compressors; Centrifugal Compressors; Axial-Flow Compressors; Compressor Selection; System Capacity Requirements; Compressor Capacity; Checking Compressor Capacity; Accessories; Packaged Compressors

Objectives

- Compare the power output of a single-stage vs a two-stage vane compressor.
- Describe the main types of positive-displacement rotary air compressors.
- Explain the advantages and disadvantages of both types of dynamic compressors.
- Describe four methods of controlling centrifugal compressor output.
- Tell how to compensate for a low-speed drive in rotary screw compressors.

Lesson 4: Primary Air Treatment

Topics

Air Treatment; Preliminary Filtering; Relative Humidity; Effects of Moisture; Water Removal; Dew Point; Moisture Separators; Oil Scrubbers; Air Dryers; Air Receivers

Objectives

- Describe techniques for cleaning compressor filters.
- Define relative humidity and dew point.
- Explain the effects of temperature and pressure on the air's ability to hold moisture.
- Describe aftercooler operation.
- Explain the functions of separators, oil scrubbers, and air dryers.

Lesson 5: Secondary Air Treatment

Topics

Methods of Treatment; Contaminant Separation; Contaminant Filtration; Filter Classification and Rating; Types of Media; Surface Filters; Depth Filters; Adsorption Filters; Absorption Filters; Lubricating the Air

Objectives

- Describe the two main methods of contaminant separation.
- Explain how filters are classified.
- List contaminant particle sizes and particle contamination categories as they occur in filters.
- List applications for the most common types of filter media.
- Identify system location for lubrication equipment installation.

Lesson 6: Piping, Hoses, and Fittings

Topics

Piping Requirements; Airflow; Piping; Pipe Applications; Metallic Tubing; Tube Bending; Tube Fittings; Tubing Installation; Nonmetallic Tubing; Hoses; Hose Fittings; Quick-Disconnect Couplings; Hose Installation

Objectives

- State the importance of laminar flow.
- List the factors that affect pressure loss in a pipe.
- State direction and amount of slope for compressor discharge pipes.
- Discuss procedures for pipe, tube, and hose installation.
- Describe safe working procedures for disconnecting air hoses.

Basic Pneumatics

Lesson 7: Directional Control Valves

Topics

Control Valves; Manually Operated Valves; Automatically Operated Valves; Control Valve Elements; Two-Way Valves; Three-Way Valves; Four-Way Valves; Five-Way Valves; Valve Accessories

Objectives

- Describe the four methods of identifying control valves.
- List four basic types of manually operated, two-way valves.
- Describe the operation of a two-position, direct acting, normally closed solenoid valve.
- Explain one major advantage of using a four-way valve.
- Describe the construction of a three-way valve.

Lesson 8: Pressure-Control Valves

Topics

Controlling Pressure; Venting Excess Pressure; Relief Valve Construction; Pressure Regulators; Regulator Modifications; Logic Functions

Objectives

- List two ways a valve can control compressor pressure output.
- Describe construction of two basic types of pressure-relief valves.
- Contrast a pressure regulator with a pressure-relief valve.
- State the limit imposed by Federal Law on the pressure allowed when an air hose is used to blow off chips.

Lesson 9: Pneumatic Cylinders

Topics

Pneumatic Cylinders; Double-Acting Cylinders; Single-Acting Cylinders; Two-Piston Cylinders; Cylinder Construction; Rod Packings; Cylinder Mounting; Selecting a Cylinder; Cushioning

Objectives

- Tell the difference between pneumatic and hydraulic cylinders.
- Describe the construction and operation of a single-acting cylinder.
- State the purpose of an exhaust flow control metering valve.
- Describe the action of a pivoted cylinder.
- Explain the size relationship between a cylinder port and a valve port.

Lesson 10: Pneumatic Motors and Rotary Actuators

Topics

Pneumatic Motors; Motor Classification; Rating and Selection Factors; Pneumatic Motor Construction; Rotary Vane Motors; Piston Motors; Rotary Actuators; Portable Air Tools; Air Boosters

Objectives

- Explain pneumatic motor classification.
- Define torque.
- Describe pneumatic motor construction.
- Calculate a motor's horsepower, given its torque and speed.
- Differentiate between a pneumatic motor and a rotary actuator.

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Chemical Hazards

Course 151: Chemical Hazards

Covers OSHA'S Hazard Communication Standard. Discusses the physical and health hazards presented by dangerous chemicals. Explains the information contained in a Safety Data Sheet (SDS).

TPC Training is accredited by IACET to offer **0.3 CEU** for this program.

Lesson 1: What the Standard Requires

Topics

The OSHA Standard; Goals of the Standard; What the Standard Requires; Identifying and Evaluating Chemical Hazards; Providing an SDS Labeling Hazardous Chemicals; Listing All Chemical Hazards; Informing and Training Employees; Exchanging Information with Contractors; Writing a Hazard Communication Program

Objectives

- Identify the goals of the Hazard Communication standard and the agency responsible for writing and enforcing the standard.
- Lost the eight fundamental actions required by the OSHA Hazard Communication standard and state the purpose of each.
- Explain the key requirements for carrying out each fundamental action.

Lesson 2: Types of Chemical Hazards

Topics

What Is a Chemical Hazard?; Physical Hazards; Health Hazards; Forms of Chemical Hazards; Exposure Routes; Key Factors That Affect the Degree of Hazard; Controlling Chemical Hazards; Detecting Exposure Hazards

Objectives

- Define chemical hazards covered by the Hazard Communication standard and the two categories into which they are divided.
- Identify the common physical forms of chemical hazards and the industrial operations that produce or release vapors, mists, dusts, and fumes.
- Name the three basic routes of exposure to health hazards.
- Explain the key factors that affect the degree of hazard.
- Discuss common methods of controlling chemical hazards.
- Explain how to detect exposure hazards and symptoms.

Lesson 3: Safety Data Sheet

Topics

What Is an SDS?; Chemical Identi ication; Physical Data; Health Hazard Information; Physical Hazard Information; Fire and Explosion Hazards; Reactive Hazards; Special Protection Information; Special Precautions and Procedures

Objectives

- Explain the purpose, availability, preparation, and basic content of SDSs.
- Give examples of the health hazard information contained in SDSs and how it is used.
- Give examples of the physical hazard information contained in the SDSs and how it is used.
- Describe typical SDS instructions on special precautions and procedures.

Machine Shop Practice

Course 315: Machine Shop Practice

Covers the principles of machining, measurement, tool grinding, and machine shop safety. Discusses the properties of metals, how to lay out and set up a job, how to use measuring devices such as the micrometer and vernier caliper, and how to read working drawings. Explains how to grind single-and multi-point tools.

TPC Training is accredited by IACET to offer **0.6 CEU** for this program.

Lesson 1: Principles of Machining

Topics

The Need for Machine Tools; Modern Machine Tools; Metal Cutting Tools; Metals Machined in the Shop; How to Identify Steels; Properties of Metals; Changing the Hardness of a Metal; Case Hardening Cutting Metal; Cutting Fluids; Cutting Speeds and Feeds; Changing SFPM to RPM; Determining Feed Rates; Chip Color and Shape; Disposing of Chips

Objectives

- Name the two main classes of machine tools.
- Tell how to identify ferrous and nonferrous metals.
- Explain methods of identifying steels.
- Define the following terms: tensile strength, compressive strength, ductility; and malleability.
- Explain various heat treating processes used with metals.
- List the functions of a cutting fluid.
- Explain how to change sfpm to rpm.
- Describe the information you can gather from chip color and shape.

Lesson 2: Layout Work and Shop Safety

Topics

Using Shop Drawings; Scribing Lines on Metal; Outside and Inside Calipers; The Square; Measuring Angles; Surface Plates; The Surface Gauge; Aids to Layout Work; Making a Layout; Laying Out Boltholes in Flanges; Four-Bolt Flange Layout; Six-Bolt Flange Layout; Eight-Bolt Flange Layout; Shop Safety

Objectives

- Describe the tools commonly used for layout work in the machine shop.
- Explain the function of a surface plate.
- Define the terms bolt circle, pitch chord, and centerline.
- List the steps involved in laying out flange holes.
- Explain shop safety practices relating to eye protection, chip removal, and tool handling.

Lesson 3: Setup Tools

Topics

Holding Devices for Lathe Operations; Holding Work between Centers; Driving Work Mounted between Centers; Holding Lathe Work in a Chuck; Mounting a Chuck on a Lathe; Removing a Chuck from a Lathe; Practical Chuck Sizes; Holding Oddly Shaped Workpieces; Supporting the Workpiece; Collet Chucks; Steady Rests and Follower Rests; Holding Work on a Machine Table; T-Slot Bolts and T-Slot Clamps; Step Blocks; V-Blocks; C-Clamps, Angle Plates, and Planer Jacks; Parallels and Hold-Downs; Drill Press Vise; Milling and Planing Vises; Swivel Vises; Air/Hydraulic Vises; Magnetic Chucks; Safety Precautions for Setup Tools

Objectives

- Explain how to hold and drive work held between centers on a lathe.
- Explain how to hold lathe work in a chuck, and how to mount and remove a chuck from a lathe.
- Define the term swing as it relates to a lathe.
- Tell how to hold oddly shaped workpieces on a lathe
- Explain when each of the following is used: collet chuck, steady rest, and follower rest.
- Explain how each of the following is used to hold work on a machine table: T-slot bolts and clamps, step blocks, V-blocks, C-clamps, angle plates, and planer jacks.
- Tell when and how to use a vise to hold a workpiece.
- List safety precautions for setup tools.

Lesson 4: Setup Measurement

Topics

The Working Drawing; Sectional View on a Drawing; Dimensions and Their Values; Precision and Tolerance; Using the Steel Rule and the Scale; How to Hold a Micrometer; Reading a Micrometer; Reading a Vernier Micrometer; Reading a Metric Micrometer; Using a Vernier Caliper; The Sine-bar and Its Use; Gauge Blocks and Their Use

Objectives

- Explain the importance of having a working drawing when machining a part.
- Define the terms section and sectional view.
- Name the three systems of dimensioning.
- Define the terms precision and tolerance.
- Define the term fit, and compare actual fit, clearance fit, interference fit, and transition fit.
- Name the simplest measuring tool in the shop.
- Explain how to hold and read a micrometer.
- Tell how to use a vernier caliper, sine-bar, and gauge blocks.

Machine Shop Practice

Lesson 5: How to Grind Single-Point Tools

Topics

Materials for Tools; Basic Single-Point Tools; Parts of a Single-Point Tool; Direction of Cutting; Specifying a Tool Size; Relief Angles; Grinders for Single-Point Tools; Grinding Wheel Marking Code; Diamond Grinding Wheels; Grinding a Single-Point Tool Bit; Grinding Finishing Tools; Grinding Grooving Tools; Grinding Threading Tools; Grinding Carbide-Tipped Tools; Using a Silicon Carbide Wheel; Using a Diamond Grinding Wheel

Objectives

- Describe the various materials used for tools.
- Identify the parts of a single-point tool.
- List important specifications for single-point cutting tools.
- Name the two basic types of grinders and explain how they are used to sharpen single-point tools.
- Explain the standard marking system for grinding wheels.
- Describe the best way to grind carbide-tipped tools.

Lesson 6: How to Grind Multi-Point Tools

Topics

Construction of a Twist Drill; Wearing Parts of a Drill; Grinding a Drill by Hand; Checking the Drill Lips and Relief Angles; Thinning the Drill Web; Types of Milling Cutters; Grinding Milling Cutters; Grinding the Cutter Relief and Clearance; Grinding End Mills; Grinding Counterbores and Countersinks; Grinding Reamers

Objectives

- Describe the construction of a twist drill, including identification of its parts.
- Explain how to perform the following operations when grinding: check the drill lips, check the relief angles, and thin the drill web.
- List the three categories of milling cutters based on the way they are mounted on a milling machine.
- Name the most common type of milling cutter for maintenance work.
- Explain how to grind end mills, counterbores, and reamers.

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Basic Hand Tools

Course 162: Basic Hand Tools

Machinist's bench vise, files, ball-peen hammers, chisels, wrenches, screwdrivers, pliers, etc.; Reamers; Thread and taps, types and usage.

Lesson 1: Basic Hand Tools

Topics

Machinist's Bench Vise Files; The Parts of a File; Single-Cut and Double-Cut Files; The Ball-Peen Hammer; Chisels; Wrenches; The Adjustable Wrench; The Allen Wrench; Open-End Wrenches; Screwdrivers; Pliers; The Hacksaw

Lesson 2: Reamers, Counterbores, and Countersinks

Topics

Reamers; Types of Reamers—Straight and Spiral Fluted Reamers; Tapered Reamers; Rose Reamers; Shell Reamers; Carbide Tipped Reamers; Inserted Blade Reamers; Reamer Selection Guide; Other Machining Operations; Countersinking; Spotfacing and Counterboring

Lesson 3: Threads and Taps in the Shop

Topics

Types of Threads; American National and Unified National Threads; Course, Fine, and Extra Fine Threads; Types of Taps

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Work Planning and Setup

Course 163: Work Planning and Setup

Using clamps, blocks, jacks, and rods; Vises and their uses; Production jig; Holding work with chucks, between centers, and on face plates; Basic layout: lines, angles, shapes, circles, and three-dimensional shapes.

Lesson 1: Holding Work on Slotted Tables

Topics

Work Holding Setups; V-Blocks; C-Clamps; Planer Jacks; Parallels; Soft Metal Rods; Hold-Downs; Types of Vises; Flanged Vise; Swivel Vise; Universal Vise;
The Production Jig; Magnetic Chucks; Electromagnetic Chuck; Permanent Magnetic Chuck

Lesson 2: Lathe Workholding Devices

Topics

Holding Work in Lathes; Holding Work in Chucks; The 3-Jaw Universal Chuck; The 4-Jae Independent Chuck; The Collet Chuck; Holding Work Between Centers; Holding Work on Faceplates

Lesson 3: Basic Layout

Topics

Lines, Angles, and Shapes; Right Angles; Straight Angles; Parallel and Perpendicular Lines; Layout Work; Triangles; Squares and Rectangles; Circles; The Parts of a Circle; Concentric and Eccentric; 3-Dimensional Shapes

Bulk-Handling Conveyors

Course 331: Bulk-Handling Conveyors

Covers belt conveyors that carry coal, sand, gravel, grain and other loose materials. Acquaints the trainee with the terminology, basic structure, and operation of these systems. Includes detailed coverage of belts, belt cleaners, idlers, and feed/discharge devices, as well as an explanation of how to install, maintain, replace, and troubleshoot these components.

TPC Training is accredited by IACET to offer **0.5 CEU** for this program.

Lesson 1: Conveyor Components

Topics

Conveyor Profiles; Conveyor Pulleys; Conveyor Idlers; Bulk-Handling Conveyor Belts; Conveyor Drive Packages; Support Components

Objectives

- Describe the basic operation of a bulk-handling belt conveyor and identify its major components.
- Name and explain the function of the different pulleys used in belt conveyors.
- Describe four popular conveyor drive-package arrangements.
- Explain the purpose and the operation of at least four of the support components of a bulk-handling belt conveyor.

Lesson 2: Bulk-Conveyor Belting

Topics

Conveyor-Belt Components; Belt Plies; Storing Conveyor Belts; Handling the Belt; Installation; Squaring Belt Ends and Cutting; Belt Fasteners; Vulcanized Splicing; Tensioning the Belt; Test Run; Retensioning; Preventive Maintenance; Replacing a Belt; Repairing Damaged Sections; Troubleshooting Conveyor Belts

Objectives

- Describe the composition and structure of the three components of a bulk-handling conveyor belt.
- State correct storage and handling procedures for bulk conveyor belts.
- Detail the installation of a belt in a bulk conveyor system, including splicing and tensioning.
- Name the five points that require special attention in a preventive maintenance program for a belt conveyor system.

Lesson 3: Belt Cleaners and Idlers

Topics

The Need for Belt Cleaners; Blade Belt Cleaners; Brush Belt Cleaners; Plow-Type Belt Cleaners; Belt Cleaning by Rollover; Using Deck Plates; Self-Cleaning Return Idlers; Wing Pulleys; Installing Belt Cleaners; Testing; Preventive Maintenance; Inspection and Maintenance; Troubleshooting Belt-Cleaning Devices

Objectives

- Describe the design and placement of blade, brush, and plow belt cleaners and the applications for which each one would be used.
- Name and describe the different types of blade belt cleaners.
- Describe the process of belt cleaning by rollover.
- Explain how devices such as wing pulleys, self-cleaning return idlers, and deck plates function as parts of a belt cleaning system.
- Describe the appropriate safety precautions to take when installing or maintaining belt cleaners.
- List the essential features of preventive maintenance and inspection for a belt cleaning system.

Lesson 4: Feed and Discharge Devices

Topics

General Considerations; Factors in Loading; Discharge Factors; Using Skirting Devices; Skirtboard Heights; Skirtboard Edgings; Intermediate Skirting; Hoppers; Hopper Accessories; Chutes at Loading Points; Chutes at Discharge Points; Spouting;Inspection and Preventive Maintenance; Troubleshooting

Objectives

- Explain two important factors in efficient conveyor loading and how they are affected by the two ways (directions) in which belt conveyors are loaded.
- Describe the construction and the purpose of skirtboards.
- Differentiate between a deadbed and a bed of fines and detail the use of both in chute loading of conveyors.
- Name and explain the operation of three special types of discharge spouts.

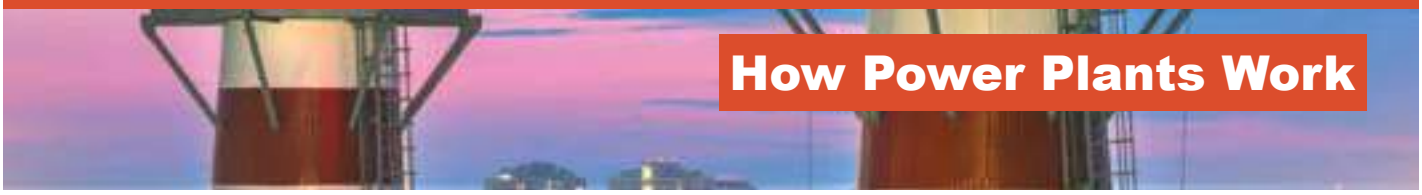
Lesson 5: Safety and Troubleshooting

Topics

Conveyor Characteristics; Conveyor Identification; Conveyor System Profiles; Loading and Discharge Points; Emergency Controls; Working Near Running Conveyor Systems; Preparing for Conveyor Maintenance; The Belt; Idlers; Pulleys; Conveyor Drive Systems; Cleaning Up After Maintenance; Test Running; Common Problems and Possible Remedies

Objectives

- Differentiate between a conveyor profile and a system profile.
- Point out the special hazards for workers at conveyor loading and discharge points.
- Explain the function and operation of the following emergency controls: electrical interlocks, backstops, level switches, pull-cords, and conveyor belt alignment switches.
- Name at least five safety measures employees should take to protect themselves when working on or near bulk-handling conveyors.
- Describe the three-step procedure for preventing accidental startup of a conveyor during maintenance work.
- Name at least one specific chore or safety caution required in maintenance work on each of the following: belts, idlers, pulleys, and drive systems.
- Identify common problems (and their probable causes) found in troubleshooting idlers, pulleys, takeup bearings, and conveyor drives.



How Power Plants Work

Course 111: How Power Plants Work

Covers the basic steam generation system, how thermal energy is converted into electrical energy, components of the system, and design features for gaining thermal efficiency. Includes handling of water, fuel, and wastes, and the operating features of a power plant.

TPC Training is accredited by IACET to offer **0.5 CEU** for this program.

Lesson 1: Steam—The Primary Force

Topics

Energy for Power Plants; Converting Energy to Electricity; The Importance of Air in Combustion; Removing Ashes and Flue Gases; Heating the Air; Boiler Design; Controlling the Water Level; Feedwater Heater; The Economizer

Objectives

- Describe the basic concepts involved in converting energy to electricity through a steam power plant.
- Explain why air is important in combustion and describe how air is heated.
- Describe the basic design of a boiler.
- List the methods commonly used to create efficiency in a boiler.

Lesson 2: How Heat is Converted to Power

Topics

The Turbine; The Generator; Using Exhausted Steam; Producing a Vacuum; Using the Condensate; Improved Coal Handling; Boiler Efficiency

Objectives

- Describe the components of an elementary turbine.
- List the uses of exhaust steam.
- Explain how a vacuum is produced in a boiler system.
- Describe how condensate is formed in a boiler system and how it can be used to create a closed cycle system.
- Explain how boiler efficiency is related to steam temperature and pressure.
- Calculate absolute temperature values using Fahrenheit and Celsius readings.

Lesson 3: Power Plant Efficiency

Topics

Thermodynamic Efficiency; Pumps; Feedwater Heating; Air Heating; The Superheater; Circulation Problems in High-Pressure Boilers; Minimum Temperatures in the System; Minor Refinements; Condenser Performance

Objectives

- List the kinds of pumps used in a boiler system and explain the function of each.
- Describe common processes by which boiler feedwater can be heated, and explain these increase boiler efficiency.
- Explain the process by which air is heated in a boiler system.
- Explain the purpose of a superheater.

Lesson 4: Handling Water, Fuel, and Wastes

Topics

Water Requirements; Physical Properties of Water; Chemical Properties of Water; Water Softening and Purification; Cooling Water; Water Disposal Problems; Air Cooling; Fossil Fuel Handling and Wastes; Flue Gases; Particle Removal; Problem Transfer; Looking to the Future

Objectives

- List the two main uses for water in a power plant.
- Describe the physical and chemical properties of water.
- Explain the past and present methods used to purify water for use in a power plant.
- Explain the common handling procedures for flue gases and solid wastes, and describe the problems involved in disposing of these wastes.
- List some of the ways in which power plant waste problems might be resolved in the future.

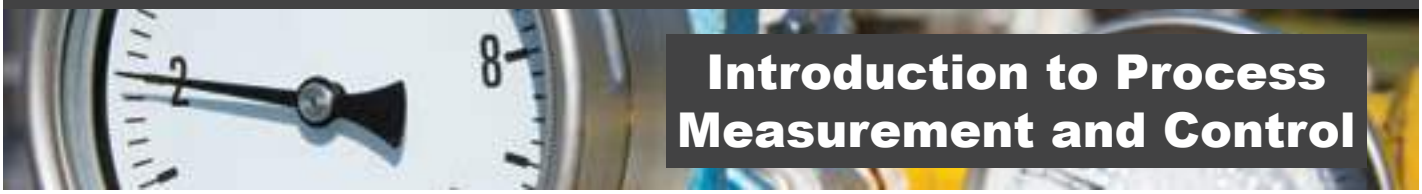
Lesson 5: Power Plant Operation and Control

Topics

Operating Features of a Power Plant; Power Plant Controls; Temperature Measurement; Pressure Measurement; Special Measurements; Other Power Sources; Nuclear Power

Objectives

- Give a detailed description of the arrangement of a modern steam generating plant and explain the progression of the steam cycle from one end to the other.
- Compare and contrast the common instruments for measuring temperature.
- Compare and contrast the common instruments for measuring pressure.
- List some of the special measurement devices that are important in a steam generating plant.
- List the alternate power sources described in the lesson.
- Explain the concept of nuclear power and describe the operation of a nuclear power plant.



Introduction to Process Measurement and Control

Course 271: Introduction to Process Measurement and Control

Covers the function of basic devices for measuring and controlling different kinds of variables in process control. Introduces closed-loop control and PID functions. Introduces analog and digital devices and programmable logic controllers (PLCs). Covers basic principles of measurement and defines process control terms. Describes several kinds of signals and displays and traces the path of a signal through the system. Explains the operation of transducers, transmitters, signal conditioners, converters, and recorders.

TPC Training is accredited by IACET to offer **0.6 CEU** for this program.

Lesson 1: The Nature of Process Control

Topics

Process Variables; On-Off Process Control; Functions of Automatic Process Control; Typical Process Control Applications; Measuring Data in Control Systems; Controlling Variables Automatically; Error, Signal Evaluation, and Feedback; Open- and Closed-Loop Control Systems

Objectives

- Define setpoint, control point, and error.
- Explain how measurement and control are related in industrial processes.
- Describe the four essential functions of an automatic control system.
- Discuss the functions of PLCs and industrial computers in control systems.
- Identify variables in industrial processes.
- Explain the importance of feedback in a closed-loop control system.

Lesson 2: Elements of Process Control

Topics

Process Operation; Analog Control Signals; Digital Control Signals; ASCII; Measuring Process Variables; Measuring Pressure; Measuring Level; Measuring Flow Rate; Digital Pulse Control; Control System Terminology; Open- and Closed-Loop Control; Controller Action

Objectives

- Discuss the differences between modern automatic control systems and older ones.
- Identify the standard signals used in process control.
- Define the terms commonly used in control terminology.
- Describe on-off, proportional, integral, derivative, and PID controller action.

Lesson 3: Process Control Signals

Topics

Process Signals; Linear and Nonlinear Transducers; Signal Operating Values; Error in Signal Measurement; Controller Output; Pneumatic Signal Transmission; Flapper-Nozzle System; Electrical Signal Transmission; Current-Pneumatic Systems; Transmission of Other Signals; Typical Control Loops

Objectives

- Discuss standard signals and linearity and explain how to calculate the value of a variable from an instrument's span and range.
- Describe five common sources of error in signal measurement.
- Discuss the basic principles governing pneumatic signal transmission and explain how a flapper-nozzle device works.
- Describe the function of the controller in a control loop.
- Discuss the basic principles governing electrical signal transmission, including Ohm's law, and list standard current and voltage signals.
- Explain the function of I/P devices in a typical control system and discuss the use of digital signals and optical signals.

Lesson 4: Process Measurement Fundamentals

Topics

The Purpose of Measurement; Kinds of Signals; Measurement Requirements; Kinds of Displays; Remote vs Local Display; Errors in Measurement Systems; Calibration; Noise; Response Time; Measurement System Deterioration; Observation Errors; Transmitters; Proportionality

Objectives

- Explain why measurement is necessary and discuss conditions that affect the degree of accuracy required.
- Compare the advantages of linear and nonlinear displays.
- Compare analog and digital devices and explain how each is applied to measurement.
- Name five sources of measurement error.
- Discuss proportionality and explain how it applies to transmitters.

Introduction to Process Measurement and Control

Lesson 5: Principles of Transducer Operation

Topics

Signal Measurement and Transmission; Matching the Transducer to the Application; Kinds of Output; Mechanical and Electrical Elements; Pneumatic Response; Relating Distortion to Pressure; Electrical Response; Resistance Devices; Voltage Response Devices; Frequency Response Devices; Electromechanical Devices; Combining Elements; Transducers and Today's Technology

Objectives

- Discuss the need for linearity in a process.
- List examples of mechanical and electrical transducer elements.
- Compare pneumatic response and electrical/electronic response in transducers.
- Describe the operation of the bourdon tube, bellows, and diaphragm.
- Give examples of resistance, voltage response, frequency response devices and explain how they work.
- Discuss the use of the Hall-effect transducer and the differential transducer.

Lesson 6: Basic Process Measurement Systems

Topics

Interaction of System Elements; Translating the Measurement; The Transmitter as Communicator; Electrical vs Pneumatic Output; Analog Signal Conditioning; Analog Signal Converters; Converting from Analog to Digital and Back; Analog Indicators; Analog Recorders; Digital Indicators and Recorders; A Complete System

Objectives

- Discuss the basic elements of measuring systems and explain how they interact.
- Describe how a physical quantity is translated into another quantity.
- Discuss the use of transmitters to relay information from one location to another and explain the transfer function.

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Pressure Measurement

Course 273: Pressure Measurement

Covers units of pressure and discusses Boyle's and Charles' laws to explain relationships among pressure, volume, and temperature. Describes sensor operation of manometers, bourdon tubes, diaphragms, and bellows. Explains the operation of potentiometric, capacitive, reluctive, servo, strain-gauge, and piezoelectric transducers. Describes devices used in low-pressure control. Discusses proper and safe methods for installing and servicing pressure instruments.

TPC Training is accredited by IACET to offer **0.5 CEU** for this program.

Lesson 1: Principles of Pressure in Liquids and Gases

Topics

Properties of Matter; Principles of Liquid Pressure; Units of Pressure; Conditions Affecting Liquid Pressure; Density and Relative Density; Gauge Pressure and Absolute Pressure; Using Liquid Pressure Measurements; Gas Pressure and Volume; Gas Volume and Temperature; Gas Pressure and Temperature; Pressure, Temperature, and Volume Related; Atmospheric Pressure; Pressure and Flow

Objectives

- Compare the three forms of matter.
- Define pressure and explain the difference between gauge pressure and absolute pressure.
- Discuss the conditions that affect the pressure of a liquid.
- Describe how changes in volume affect the pressure of a gas at a constant temperature.
- Describe how changes in temperature affect the volume of a gas at constant pressure, and the pressure of a gas with a constant volume.
- Discuss the two causes of pressure drop in a pipe carrying liquid from a tank.

Lesson 2: Pressure Sensors

Topics

Functions of Measuring Instruments; Manometers; Bourdon Tube Sensors; C-Shape Bourdon Tube; Other Bourdon Tube Shapes; Bourdon Tube Metals; Diaphragm Pressure Sensors; Diaphragm Construction; Diaphragm Capsule Elements; Bellows Pressure Sensors; Sensor Application Comparisons; Maintaining Accuracy; Calibration; Pressure Switches

Objectives

- Explain how a manometer works.
- Describe four kinds of bourdon-tube sensors.
- Discuss construction details of bourdon tubes, diaphragms, and bellows.
- Explain how bellows pressure sensors work.
- Describe how calibration may be accomplished and list the steps in calibrating a pressure gauge.
- Explain how normally open and normally closed pressure switches work.

Lesson 3: Pressure Transducers

Topics

Pressure Conversion; Potentiometric Pressure Transducers; Pressure-to-Current (P/I) and Pressure-to-Pressure (P/P) Transducers; Capacitive Pressure Transducers; Reluctance; Reluctive Pressure Transducers; Servo Pressure Transducers; Strain Gauge Pressure Transducers; Piezoelectric Pressure Transducers; Response Comparisons; Environmental Considerations

Objectives

- Discuss the advantages and disadvantages of the potentiometric pressure transducer.
- Explain how a P/I transducer works.
- Describe the operation of capacitive, reluctive, and servo pressure transducers.
- Compare the three kinds of strain gauge pressure transducers.
- Describe the operation and advantages of the piezoelectric pressure transducer.
- Discuss three environmental conditions that can affect transducer operation.

Lesson 4: Low-Pressure Measurement

Topics

Vacuum; Low Pressure; Units of Low-Pressure Measurement; Methods of Conversion; DP Transmitters; Pressure Gauges; Slack-Diaphragm Gauge; Ionization; McLeod Gauge; Capacitance Manometer; Thermal Conductivity Gauges; Pirani Gauge; Thermocouple Gauge

Objectives

- Define the pressure unit torr and calculate pressure in specified units when given the pressure in other units.
- Explain the operation of a differential-pressure transmitter and a slack-diaphragm gauge.
- Name two kinds of ionization gauges and describe how they work.
- Explain how the McLeod gauge works.
- Describe the capacitance manometer.
- Compare the operation of the Pirani gauge and the thermocouple gauge.

Pressure Measurement

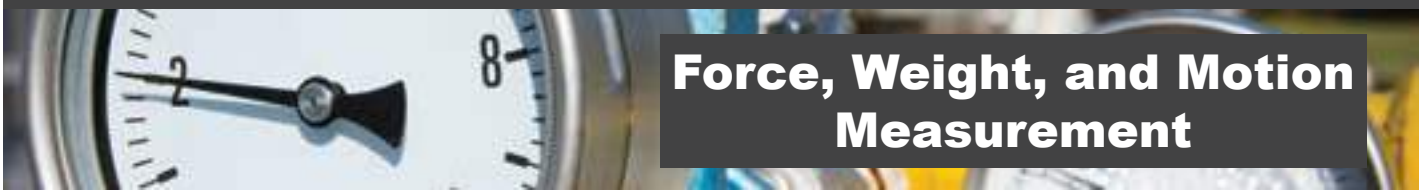
Lesson 5: Installation and Service

Topics

Components of Pressure Transmitters; Pressure Tap, Diaphragm Seal, and Pulsation Dampener; Isolation Valve, Instrument Valve, and Blowdown Valve; Instrument Piping, Connections, and Fittings; Locating and Mounting the Instrument; Piping; Electrical Wiring; Placing the Instrument into Service; Guidelines for Periodic Maintenance; Calibration; Troubleshooting and Repair; Instrument Shop; Safety

Objectives

- List the components of a pressure-transmitter installation.
- Compare methods of joining pipes and other instrumentation components.
- Describe the procedure for placing a pressure instrument into service.
- Discuss the elements of periodic maintenance.
- Explain how to calibrate pressure instruments with electrical and pneumatic outputs.
- Describe three important techniques used in troubleshooting and repair.
- List five important safety rules.



Force, Weight, and Motion Measurement

Course 274: Force, Weight, and Motion Measurement

Covers force, stress, and strain and explains the operation of strain-gauge systems. Relates weight to mass and scales to balances. Explains the operation of load-cell scales. Describes belt-scale, nuclear-scale, and weigh feeder operation. Covers position measurements by means of proximity detection, air gauging, LVDT gauges, synchros, code disks, and other devices. Explains machine tool control and accelerometer operation. Describes the measurement of angular velocity and acceleration, vibration detection, and machinery balancing.

TPC Training is accredited by IACET to offer **0.5 CEU** for this program.

Lesson 1: Force, Stress, and Strain

Topics

Force and Motion; Units of Force; Static Forces; Effects of Static Forces; Elasticity; Strain Gauges; Gauge Factor; Measurement Systems for Strain Gauges; Gauge Configurations; Other Force-Measuring Devices

Objectives

- Define force, stress, strain, and deformation in terms of the English and SI units used for their measurement.
- Describe the relationship between stress and strain (Hooke's law).
- Describe the operation and construction of various kinds of strain gauges.
- Identify the electrical circuits used with strain gauges.
- Describe the piezoelectric effect and the capacitance mat and discuss typical applications.

Lesson 2: Weight and Mass Measurement

Topics

Weight vs Mass; Acceleration; Units of Mass and Force; Measuring Weight and Mass; Spring Scales; Equal-Arm Balances; Unequal-Arm Balances; Load Cell Scales; Hydraulic Load Cell; LVDT Load Cell; Pneumatic Load Cell; Industrial Batch Scales

Objectives

- Define and compare weight and mass, including SI and English units.
- Explain the relationship between a mass and the acceleration of that mass.
- Discuss Newton's first law of motion.
- Describe spring scales, equal-arm balances, and unequal-arm balances.
- Discuss the operating principles governing load cells.
- Describe the operation and application of industrial batch scales.

Lesson 3: Weighing Materials in Motion

Topics

In-Transit Weights; Belt Scale Systems; Roller Scales; Calibration of In-Transit Scales; Principles of Nuclear Scale Operation; Radiation Detectors; Weigh Feeders

Objectives

- Name the parts of a belt scale and explain how a typical belt scale operates.
- Discuss the use of roller scales.
- Describe the scale comparison, calibration chain, and electronic integrator methods of calibrating in-transit scales.
- Explain how radiation detectors work and describe the operation of a nuclear scale.
- Describe how continuous weigh feeders operate and discuss typical applications.

Lesson 4: Position Measurements

Topics

Linear Position Measurements; Micrometers and Dial Indicators; Potentiometers; Tracer Systems; Variable-Reluctance Transducer; Proximity Detection; Air Gauging; Moving-Coil Transducer; LVDT Gauge; Inspection Gauging; Angular Position Measurements; Synchros; Code Disk (Encoder); Geologic Position Measurements; Full-Field Devices

Objectives

- Describe how micrometers and dial indicators are used to gauge an object and to make a position measurement.
- Explain how precision potentiometers, tracer systems, variable-reluctance transducers, and proximity detectors measure linear position.
- Describe how air gauging is used to measure inside and outside diameters.
- Discuss the operation and uses of LVDT gauge heads.
- Explain how typical rotary potentiometers, synchros, and code disks converters operate.
- Discuss applications for extensometers and full-field devices.

Lesson 5: Acceleration, Vibration, and Shock

Topics

Linear Motion; Speed vs Velocity; Radar Devices in Traffic Control; Machine Tool Control; Linear Acceleration; How an Accelerometer Works; Angular Velocity and Acceleration; Vibration; Balancing Machinery

Objectives

- Compare speed and velocity and calculate speed from distance and time.
- Explain how the accelerometer works.
- Contrast direct and indirect speed measurement and give examples of each.
- Discuss the operation of LVDT, potentiometric, and piezoelectric accelerometers.
- Describe the undesirable effects of vibration and discuss ways of preventing them.

Flow Measurement

Course 275: Flow Measurement

Covers principles of fluid flow and how primary devices affect fluid flow. Describes flow measurement using several kinds of secondary devices. Discusses rotameters and other variable-area instruments. Explains how weirs, flumes, and other arrangements measure open-channel flow. Compares many kinds of positive-displacement meters and explains the operation of several kinds of turbine and magnetic flowmeters. Describes less-common flowmeters (including vortex-precession, mass flow, and ultrasonic devices) and instruments that meter the flow of solids. Provides guidelines for safe installation and maintenance of flow devices.

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.

Lesson 1: Properties of Fluid Flow

Topics

Importance of Flow Measurement; Basic Properties of Fluids; Fluids in Motion; Getting Fluids to Flow; Establishing a Pressure Difference; Ways of Indicating Fluid Flow Rate; Conditions Affecting Flow Rate; Reynolds Number

Objectives

- Explain the difference between density and relative density (specific gravity).
- Define fluid velocity, viscosity, and volume flow rate.
- Describe laminar flow and turbulent flow.
- Explain how static head, friction head, and velocity head differ from each other.
- Explain how pipe size, pipe friction, and fluid viscosity affect the measurement of fluid flow.

Lesson 2: Primary Measuring Devices

Topics

Flow Classification; Flow Measurement Methods; Flow Measurement in Completely Filled Pipes; Restricting the Flow; Pressure Drop; The Orifice Plate; Orifice Plate Design Features; Special Kinds of Orifice Plates; Annular Orifice and Wedge Element; The Flow Nozzle; Turndown and Rangeability; Location of Pipe Taps; Straight Pipe Requirements

Objectives

- Describe direct and indirect flow measurement methods.
- Describe how a primary device creates a differential pressure.
- Give at least three examples of common primary devices and explain how each works.
- Describe the significant features of orifice plates and explain their functions.
- Discuss the conditions that determine the length of straight pipe required for each kind of primary flowmeter.

Lesson 3: Secondary Measuring Devices

Topics

Secondary Measuring Devices; Basic Manometer Design; Liquid Pressure Measurement; Reading the Meniscus; Wet and Dry Manometers; Calibrating a Manometer; Hazards of Mercury; Bellows Meter; ΔP Transmitter; Integral-Orifice Transmitter; Vibrating-Wire Transmitter; Target Meter; Elbow-Mounted Measuring Device; Deadweight Tester

Objectives

- Explain why both accuracy and precision are required in a secondary measuring device.
- Describe how an inclined manometer differs from a conventional U-tube manometer.
- Explain how to calibrate dry and wet manometers.
- Give examples of secondary measuring devices and explain how they work.
- Explain how to calibrate a differential pressure transmitter and discuss the different outputs available.

Lesson 4: Variable-Area Instruments

Topics

The Rotameter; Reading a Rotameter; Conditions Affecting Rotameter Performance; Measuring Gas Flow; Relative Density, Pressure, and Temperature; Float and Tube Shapes; Special Uses for Rotameters; Piston and Vane Variable-Area Meters; Special-Purpose Variable-Area Meters

Objectives

- Discuss the similarities and differences between rotameters and orifice instruments.
- Compare the benefits of linear and nonlinear scales and explain how a square-root extractor is used.
- Explain how calibration, relative density, viscosity, and temperature affect rotameter readings.
- Describe how changes in the pressure, temperature, and relative density of a gas affect the ability of a rotameter to measure its flow rate.
- Discuss the operation of piston- and vane-type flowmeters and explain why armored rotameters and orifice-plug flowmeters are used.

Lesson 5: Open-Channel Flow Devices

Topics

Principles of Open-Channel Flow; The Weir; Shapes of Notches; Choice of Notch Shape; Design of a Weir; Weir Plate; Weir Precautions; Weir Maintenance; Using Nomographs to Calculate Flow; Flumes (Parshall Flume); Flume Terms; Flume Uses; Flume Maintenance; Ultrasonic and Capacitance Level Sensors

Objectives

- Describe the structure and function of a weir.
- Identify various weir components—notch, crest, pond, bulkhead, and head gauge.
- Describe the construction and function of a Parshall flume.
- Identify the parts of a Parshall flume—crest, throat, stilling well, and diverging and converging sections.
- Explain how ultrasonic and capacitance-level measuring devices are used to detect open-channel flow rates.

Flow Measurement

Lesson 6: Positive-Displacement Meters

Topics

Operation of Positive-Displacement Meters; Advantages and Disadvantages of Positive-Displacement Meters; Piston Meters; Reciprocating Piston Meter; Oscillating Piston Meter; Rotating-Vane Meter; Nutating-Disk Flowmeter; Lobed Impeller and Oval Flowmeters; Helix Flowmeters; Dry-Gas Bellows Meter; Calibrating Positive-Displacement Meters; Comparison of Positive-Displacement Meters

Objectives

- Describe the advantages and disadvantages of positive-displacement meters.
- Describe the operation of the reciprocating piston meter and the oscillating piston meter.
- Describe the operating principles of the sliding-vane rotary meter and the nutating-disk meter.
- Identify the elements in lobed impeller, oval, and helical flowmeters.
- Explain the operation of a dry-gas bellows meter.
- Discuss the calibration of positive-displacement meters.

Lesson 7: Turbine and Magnetic Flowmeters

Topics

Turbine Flowmeter Operation; Turbine Flowmeter Construction; Magnetic Pickups and Readout Instruments; Kinds of Turbine Flowmeters; Paddlewheel Flowmeters; Installation of Turbine Flowmeters; Advantages and Disadvantages of Turbine Flowmeters; Magnetic Flowmeters—Principle of Operation; Magnetic Flowmeter Construction; Magnetic Flowmeter Outputs; Installation Tips; Advantages and Disadvantages of Magnetic Flowmeters

Objectives

- Describe the operating principles governing turbine flowmeters.
- Discuss the construction of turbine flowmeters.
- Discuss the advantages and disadvantages of turbine flowmeters.
- Describe the operating principle governing magnetic flowmeters.
- Describe significant advantages and disadvantages of magnetic flowmeters.

Lesson 8: Specialized Flowmeters

Topics

Vortex-Precession Meters; Output System for Vortex-Precession Meters; Features of Vortex-Precession Meters; Vortex-Shedding Meters; Features of Vortex-Shedding Meters; Mass Flow; Mass Flowmeters; Thermal Flowmeters; Heat-Transfer Meter; Immersion-Probe Meter; Hot-Wire Meter; Ultrasonic Flowmeters; The Doppler-Shift Method; The Beam-Deflection Method; The Frequency-Difference Method; Characteristics of Ultrasonic Flowmeters

Objectives

- Discuss in detail the operation of a vortex-precession meter.
- Define the term vortex-shedding and describe vortex-shedding meters and their output system.
- Explain mass flow and describe a Coriolis meter.
- Describe three kinds of thermal flowmeters.
- Describe the Doppler-shift, beam-deflection, and frequency-difference methods used by ultrasonic flowmeters.

Lesson 9: Metering the Flow of Solid Particles

Topics

Measuring Volumetric and Mass Flow Rate of Solids; Volumetric Solids Flowmeter; Mass Flowmeter for Solids; Belt-Style Solids Meter; Belt-Speed Sensing and Signal Processing; Slurries; Constant-Weight Feeders

Objectives

- Define the term meter factor and explain how it is obtained.
- Explain the operation of a mass flowmeter.
- Discuss the operation of the belt-type solids meter.
- Describe how a slurry is made, transported, and metered.
- Discuss the continuous measurement and control of the flow of solid material in a process.

Lesson 10: Installation and Maintenance of Flow Instruments

Topics

Components of Flow-Measurement Systems; Primary Flow Elements; Pressure Taps; Piping and Fittings; Valves; ΔP Instrument; Miscellaneous Items; Installation of the Flow-Measurement System; Pressure Tap Installation; Instrument Piping Installation; Electrical Hookup—The Final Step; Maintenance Precautions; Preventive Maintenance; Calibration; A ΔP Instrument Calibration Procedure

Objectives

- Describe components of a differential flow measurement system.
- List guidelines for correct installation.
- Discuss the principles of thorough and safe instrument maintenance.
- List the steps in instrument calibration.
- Discuss the basic rules of safety in instrument servicing.

Level Measurement

Course 276: Level Measurement

Covers principles governing various methods of measuring level. Explains operation of conductive, capacitive, resistive, ultrasonic, and photoelectric devices. Compares the operation of several kinds of pressure-head instruments. Explains the measurement of solids by ultrasonic, microwave, radiation, and other methods. Discusses several special-application devices for both continuous and point level measurement.

TPC Training is accredited by IACET to offer **0.5 CEU** for this program.

Lesson 1: Principles of Level Measurement

Topics

Measuring Liquid Level; Surface-Sensing Gauges; Storage-Tank Gauges; Sight Glasses; Magnetic Gauges; Buoyancy; Displacer Gauges; Level Switches; Mercury Level Switches; Level Switches with Multiple Displacers; Magnetic Reed Switches

Objectives

- Define datum point, and contrast direct and indirect level measurement.
- Describe the main kinds of surface-sensing gauges.
- Define buoyant force and explain how it is used in displacer gauges to measure liquid level.
- Describe maintenance procedures for float devices, displacer gauges, and sight glasses.
- Compare the use of sight glasses, mercury level switches, and magnetic reed switches.

Lesson 2: Electrical Instruments

Topics

Conductivity and Liquid Level; Using Capacitance to Measure Level; Capacitance Probes; Capacitance Probe Electronics; Zero and Span Adjustments; Ultrasonic Level Detectors; Resistance Level Detectors; Photoelectric Level Detectors; Point Level Detection

Objectives

- Differentiate between continuous and point level measurements, and between direct and indirect level measurement.
- Describe the operation of a conductance probe in a conducting liquid.
- Describe the operation of a capacitance probe in a dielectric liquid.
- Explain the operation of ultrasonic, resistance, and photoelectric level sensors.
- Describe conductance point level probes, capacitance point level probes, and ultrasonic point level detectors.

Lesson 3: Pressure Head Instruments

Topics

Hydrostatic Pressure; Relative Density (Specific Gravity); Pressurized Fluids; Pressure Head; Pressure Head Instrumentation; Air Bellows; Air Purge Systems; Liquid Purge Systems; Force-Balance Diaphragm Systems; Differential Pressure Transmitters; Density Measurement; Safety

Objectives

- Define hydrostatic pressure and explain how it is calculated by means of the relative density (specific gravity) of a liquid in a tank.
- Discuss the relationship between pressure head and the location of the pressure (level) indicator.
- Compare the air bellows and air purge systems and discuss advantages for each.
- Explain how a force-balance diaphragm system works.
- Describe the operation of a differential pressure transmitter and explain how it is used to measure level and density.

Lesson 4: Solid Level Measurement

Topics

Using Weight to Determine Level; Ultrasonic Solid Level Measurement; Microwave Solid Level Measurement; Ultrasonic and Microwave Solid Level Detectors; Radiation Level Detectors; Capacitance and Resistance Probes; Bob-and-Cable Tension Method; Point Level Detection; Controlling Level within a Band

Objectives

- List the data needed to compute the level of a bulk solid in a bin.
- Describe and compare the operation of wire strain gauges and semiconductor strain gauges.
- Compare the advantages and disadvantages of ultrasonic and microwave level measuring methods.
- Discuss the operation of capacitance probes, resistance probes, and bob-and-cable units in measuring bulk solids.
- Describe how diaphragm switches and tilt switches are used for point level detection in automatic bin fillers.
- Discuss the use of rotating paddle detectors in controlling level within a band.

Lesson 5: Other Level Measurement Instruments

Topics

Radiation Level Detectors; Ionization Radiation Sensors; Semiconductor Radiation Sensors; Photoelectric Radiation Sensors; Infrared Level Detectors; Measuring Interface Levels; Range Suppression and Elevation; Selection of Level Measurement Equipment; Calculation of Contents

Objectives

- Explain how radiation level detectors are used for both continuous and point level measurement.
- Describe the operation of ionization radiation sensors, semiconductor radiation sensors, and scintillation counters.
- Discuss the operation of an infrared point level detector.
- Describe several methods of measuring interface levels.
- Explain how range suppression and range elevation are used.
- Discuss the important considerations in equipment selection.

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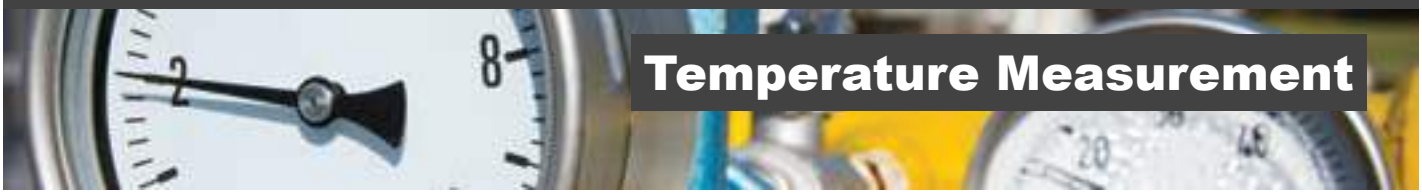


Temperature Measurement

Course 277: Temperature Measurement

Covers units in thermal measurement and operation of RTDs (and wheatstone bridges), thermistors, and thermocouples and thermometers. Includes principles of pyrometry and operation of narrowband, broadband, and bandpass pyrometers. Discusses calibration standards, typical calibrating methods, and instrument testing.

TPC Training is accredited by IACET to offer **0.5 CEU** for this program.

Lesson 1: Temperature Measurement Principles and Indicators

Topics

Temperature; Heat; Specific Heat; Changing Physical State; Fahrenheit and Celsius Temperature Scales; Rankine and Kelvin Scales; Calibration of Temperature Scales; Primary and Secondary Standards; Industrial Uses of Temperature Measurements; Temperature-Measuring Instruments; Color Change as a Temperature Indicator; Melting Point as a Temperature Indicator

Objectives

- Define thermal energy and explain the relationships among thermal energy, heat, and temperature in a substance.
- Correlate changes in temperature with changes in a substance's physical state.
- Compare four temperature scales, and convert temperature readings from one scale to another.
- Explain how primary and secondary temperature calibration standards are used.
- Describe various temperature-measuring devices and contrast thermometers and pyrometers.

Lesson 2: Bimetallic and Fluid-Filled Temperature Instruments

Topics

Bimetallic Thermometers; Liquid-in-Glass Thermometers; Filled-System Thermometers; Liquid-Filled Systems; Gas-Filled Systems; Vapor-Pressure Systems; Thermometer Bulbs; Capillary Tubes and Bourdon Tubes; Temperature Transmitters for Filled Systems; Advantages and Disadvantages of Filled Systems

Objectives

- Discuss the physical characteristics and operation of bimetallic thermometers.
- Describe how liquid-in-glass thermometers are constructed and how they operate.
- Compare liquid-, gas-, and vapor-filled systems and discuss their advantages and disadvantages.
- Explain how a mercury thermometer operates.

Lesson 3: Electrical Instruments

Topics

How Resistance Thermometers Work; Wheatstone Bridge Circuits; Lead-Wire Error; RTD Elements; Advantages and Disadvantages of RTDs; Thermistors; Advantages and Disadvantages of Thermistors; Thermocouples; Extension Wires; Compensating for Changes in Reference-Junction Temperature; Advantages and Disadvantages of Thermocouples

Objectives

- Discuss the relationship between temperature and electrical resistance.
- Describe the function of RTD bridge circuits and explain how to calculate lead-wire errors.
- Compare the accuracy, response time, stability, and circuit complexity of RTDs and thermistors.
- Describe the operation of a thermocouple and explain how to compensate for changes in the reference junction temperature.

Lesson 4: Pyrometry

Topics

Molecular Activity and Electromagnetic Radiation; Principles of Pyrometry; Effects of Emittance; Effects of Temperature; Wavelength of Radiated Energy; Pyrometers and Wavelengths; Narrowband Pyrometers; Manual Optical Pyrometers; Using the Optical Pyrometer; Automatic Optical Pyrometers; Broadband Pyrometers; Using the Broadband Pyrometer; Bandpass Pyrometers

Objectives

- Discuss the principles that govern noncontact thermal measurements.
- Define electromagnetic radiation and emittance.
- Discuss the characteristics of a blackbody.
- Describe the effects of temperature and emittance on radiation intensity.
- Describe the operation of optical and radiation pyrometers.

Temperature Measurement

Lesson 5: Temperature Instrument Maintenance and Calibration

Topics

Primary Calibration Standards; Primary Standard Instruments; Secondary Standard Instruments; Instrument Inspections; Controlled-Temperature Environments; Using Triple-Point Baths; Ice Baths; Other Fixed-Temperature References; Calibration and Testing Methods

Objectives

- Compare and define primary, secondary, and working calibration standards.
- Describe typical testing procedures for temperature-measuring instruments.
- Describe routine maintenance and calibration procedures for temperature-measuring instruments.
- Explain how to use controlled-temperature environments—ice baths, triple-point baths, fluid baths, and fluidized baths.
- Explain how to calibrate liquid-in-glass thermometers, thermocouples, resistance thermometers, and pyrometers.

Programmable Logic Controllers

Course 298: Programmable Logic Controllers

Covers the basic hardware and operating principles of PLCs, their inputs and outputs, programming, maintenance/troubleshooting, and networking.

TPC Training is accredited by IACET to offer **0.7 CEU** for this program.

Lesson 1: Introduction to Programmable Logic Controllers

Topics

The Electromagnetic Relay; Characteristics of Programmable Controllers; Applications of Programmable Controllers; Limitations of Programmable Controllers; Parts of a Programmable Logic Controller System; The Input Side; The Processor; The Output Side; Programming Devices; Power Supplies

Objectives

- Describe an electromagnetic relay and define the terms control circuit, power circuit, NO and NC.
- Define programmable logic controller.
- Describe the general type of application in which a programmable logic controller would best be used, and give examples.
- Define scan time.
- Name each of the blocks in a block diagram of a programmable logic controller system and explain how each functions within the system as a whole.
- Define memory and explain the different types.

Lesson 2: Number Systems and Logic

Topics

Number Systems; Binary-Coded Decimal (BCD); ASCII; Gray Code; Boolean Logic; Ladder Logic

Objectives

- Compare the decimal, binary, octal, and hexadecimal number systems.
- Explain the purpose for using each of the following: BCD, Gray code, and ASCII.
- Explain what AND, OR, and NOT mean in Boolean logic, and identify the symbols for each.
- Identify AND and OR logic circuits in a relay ladder diagram, and construct a truth table for each.
- Explain the basic concepts of ladder logic.

Lesson 3: Programming the System

Topics

PLC Programming; Ladder Logic Programming; Boolean Programming; The AND Instruction; The OR Instruction; The Stack Register

Objectives

- Explain the relationship between a programmable logic controller processor and program.
- Define the term scan and explain the basic steps involved in a scan.
- Explain the basic concepts of ladder logic programming.
- Explain the purpose of a parallel branch in a ladder logic program.
- Explain the basic concepts of Boolean programming.
- Define stack register and state the stack rule.

Lesson 4: Input/Output Devices and Modules

Topics

Definition of I/O Devices; Discrete Input Devices; Analog Input Devices; Digital Input Devices; Discrete Output Devices; Analog Output Devices; Sourcing and Sinking; Definition of I/O Modules; Input Modules; Output Modules

Objectives

- Explain the operation of common input and output devices and identify their symbols.
- Describe the relationship of an input/output device to a terminal on an input/output module.
- Contrast the basic concepts of a sourcing device and a sinking device.
- Explain the operation of various input and output modules.

Lesson 5: Developing a Programmable Logic Controller System

Topics

Before You Begin; Equipment Operation Specifications; Sizing the System; Program Development; Assembling the Documentation Package; Functional Model; Startup and Debugging

Objectives

- Explain the importance of working with accurate information from a specification.
- Demonstrate how to size a system.
- List the elements in a good documentation package.
- Name the steps involved in specifying the hardware and developing the program for a simple control system.
- Describe system startup and debugging procedures.

Lesson 6: Maintenance and Troubleshooting

Topics

The Importance of Documentation in Maintenance Troubleshooting; Using the Hardware Documentation; The Maintenance Log; Using the Program Documentation; Operational Documentation; Routine Maintenance; Batteries; Troubleshooting; Problems in Troubleshooting; Troubleshooting in Practice

Objectives

- Explain the importance of good documentation.
- Tell what type of information can be found in user's manuals and operations manuals.
- Tell what types of logs are kept and why they are necessary.
- Explain the major concepts of troubleshooting, including problems sometimes encountered.
- Describe routine maintenance procedures required by a programmable controller system.

Programmable Logic Controllers

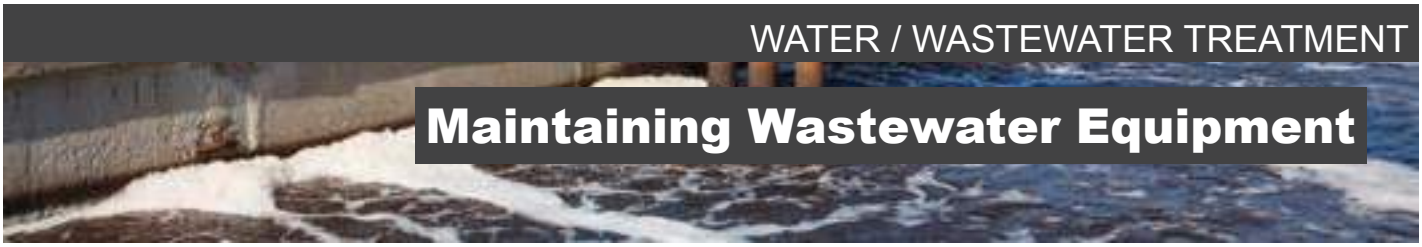
Lesson 7: System Expansion and Data Networks

Topics

I/O Expansion; Configuring the System; Math and Data Handling Instructions; Timers and Counters; The Shift Register; Spray Booth Retrofit; Indexing Table Retrofit; Local Area Networks; Uses for LANs; Transmission Media; Transmission Schemes; Vendor Offerings

Objectives

- Compare the procedures involved in local and remote I/O expansion.
- Explain what is meant by configuring a system.
- Describe the operation of the shift register instruction.
- Explain how math and data-handling instructions work and why they are added to PLC systems.
- List important items to consider in I/O expansion and retrofitting.
- Define the terms local area network, baud rate, and throughput.
- List and explain the contents of a data packet used in LAN data transmission.
- Name and define the three main applications of LANs.
- List advantages and disadvantages of the three common transmission media used with LANs.



Maintaining Wastewater Equipment

Course 383: Maintaining Wastewater Equipment

Covers the equipment used in handling and treating wastewater. Outlines correct facility maintenance procedures, including necessary checks and testing of solids handling equipment. Covers the maintenance of flow measurement devices and the safety precautions of workers in the treatment plant environments.

TPC Training is accredited by IACET to offer **0.5 CEU** for this program.

Lesson 1: Pumping Stations

Topics

Collection Systems; Pumping Stations; Pumping Station Components; Pump Operation; Pump Types; Pump Maintenance; Pump Drive Units; Piping System; Ventilation System; Control System; Level Detection; Station Start-Up and Shutdown; Station Operation and Maintenance; Safety Considerations

Objectives

- Describe a typical collection system layout.
- Name the three types of pumping stations currently in use and explain how they differ.
- List seven basic components of wet-well and dry-well stations.
- Use the following terms in an explanation of pump operation: impeller, shroud, volute case, stuffing box, shaft sleeve, wearing ring.
- Name the important elements of a good preventive maintenance program for pumps.
- Explain the importance of a pump station ventilation system.
- Demonstrate the necessary procedures to follow before pump start-up.

Lesson 2: Screening and Grinding Equipment

Topics

Hand-Cleaned Bar Screens; Mechanically Cleaned Bar Screens; Grinders; Rotating Drum Comminutors; Stationary Screen Comminutors; Barminutors

Objectives

- Name the two basic parts of a hand-cleaned bar screen and explain their functions.
- Describe the operation of a mechanically cleaned bar screen.
- Explain why grinders are used and how they are maintained.
- Compare and contrast a rotating drum comminutor and a stationary screen comminutor with an oscillating cutter.
- Explain how a Barminutor combines the functions of a bar screen and a comminutor.
- Give examples of important safety rules to follow when working with screening and grinding equipment.

Lesson 3: Grit Removal Systems

Topics

The Nature of Grit; Hand-Cleaned Grit Chambers; Maintaining Hand-Cleaned Grit Chambers; Detritus Tanks; Maintaining Detritus Tanks; Chain and Flight Grit Collectors; Maintaining Chain and Flight Grit Collectors; Aerated Grit Chambers and Cyclone Separators; Maintaining Aerated Grit Chambers

Objectives

- Tell why grit removal is important.
- Name the three phases of the grit removal process.
- Explain the functions of slide gates and dewatering drains in hand-cleaned grit chambers.
- Describe the action of a reciprocating rake and explain its purpose.
- List several maintenance checks to make on chain and flight grit collectors.
- Explain how an aerated grit chamber works and how to tell if it is not working correctly.
- Describe the operation of a cyclone grit separator.

Lesson 4: Sludge- and Scum-Collection Apparatus

Topics

Sedimentation; Rectangular Clarifiers; Scum Removal; Circular Clarifiers; Pre-Operational Checks; Daily Maintenance Activities; Sludge Removal; Laboratory Testing; Troubleshooting; Safety Considerations

Objectives

- List the five major components common to all clarifiers.
- Describe the operation of slotted pipe and helical-type skimmers.
- Name the two flow patterns possible in circular clarifiers.
- Discuss the daily maintenance requirements of clarifiers.
- Explain the importance of laboratory testing on the contents of a clarifier.
- Identify possible safety hazards associated with clarifier operation.

Maintaining Wastewater Equipment

Lesson 5: Flow Measurement Devices

Topics

Properties of Flowing Liquids; Flow Measurement Methods; Flow Measurement in Batch Processes; Flow Measurement in Open Channels; Measuring Flow from Freely Discharging Pipes; Methods of Depth Measurement; Flow Measurement in Completely Filled Pipes; Methods of Pressure Measurement; Maintenance of Flow Measurement Devices

Objectives

- Define flow and differentiate between flow rate and total flow.
- List the three basic types of flow systems.
- Distinguish between direct and indirect flow measurements, and between primary and secondary devices.
- Give a brief description of a current meter, a pitot tube, a weir, and a flume, and tell how each functions in open channels.
- Describe several methods of measuring flow from freely discharging pipes.
- Name at least five level detection devices and explain their operation.
- Describe the following flow measurement devices as they are used in completely filled pipes: orifice, venturi, flow nozzle, rotameter, magnetic flowmeter, and ultrasonic flowmeter.