Maintenance Tech Classes - Manager

Total hours for certification	**452.00**
Average hours per week	**4.26**
Window of availability	**2 years**

	Hours	Weekly Hrs
Curriculum 1	**206.5**	**3.97**
Curriculum 2	**245.5**	**4.72**

Fundamentals

Class #	Topic	Curriculum	Hours To Complete
101	Reading Blueprints	1	9
102	Reading Schematics	1	9
104	Making Measurements	1	9
105	Metals in Plant	1	9
106	Non-Metals in Plant	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
203	Transformers and AC Units	2	9
204.1	Electrical Measurement Tools	2	9
205.1	Electrical Safety and Protection	2	9
207	Single Phase Motors	2	9
208	Three Phase Motors	2	9
209	AC Controls and Equipment	2	9
210	Electrical Troubleshooting	2	9
212	Variable Frequency	2	9

Mechanical Systems

Class #	Topic	Curriculum	Hours To Complete
301	Basic Mechanics	1	9
302	Lubricants and Lubrication	1	9
303.1	Power Transmission	1	9
304	Bearings	1	9
305	Pumps	1	9
306	Industrial Piping	1	9
307	Basic Hydraulics	1	9
308	Hydraulic Troubleshooting	1	9
309	Basic Pneumatics	1	9
310	Pneumatic Troubleshooting	1	9

Electronics

Class #	Topic	Curriculum	Hours To Complete
251	Semiconductors	2	5
252	Power Supplies	2	5
253	Amplifiers	2	5
254	Oscillators	2	5
291	Digitial Logic Controllers	2	5

Energy Conservation

Class #	Topic	Curriculum	Hours To Complete
376	Energy Conservation Basics	1	5
379	Mechanical Energy Conservation	1	5
380	Electrical Energy Conservation	1	5

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	2	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
112	Generating Steam in Plant	2	4.5
113	Utilizing Steam in Plant	2	4.5
114	Waste to Energy Fundamentals	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
278	Analytic Measurement	2	5
280	Safety Calibration and Testing	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**
381	Intro to Water Technology	2	5.5
382	Wastewater Treatment Process	2	5.5
383	Maintaining Waste Water Equip	2	5.5

Rigging Equipment			
Class #	**Topic**	**Curriculum**	**Hours To Complete**
318	Industrial Rigging Practices	2	7
319	Equipment Installations	2	5

Mechanical Mtnc Applications			
Class #	**Topic**	**Curriculum**	**Hours To Complete**
341	Mechanical Drives	2	4.5
342	Mechanical and Fluid Drives	2	4.5
343	Bearing and Shaft Seal Maintenance	2	4.5
344	Pump Installation and Maintenance	2	4.5
345	Maintenance Pipefitting	2	4.5
346	Tubing and Hose Systems	2	4.5
347	Valve Maintenance and Piping	2	4.5

COMING SOON! Administration			
Class #	**Topic**	**Curriculum**	**Hours To Complete**
	OSHA 10 Hour Training	1	Coming Soon!
	Leadership Training	2	Coming Soon!

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.

Metals in the Plant

Course 105: Metals in the Plant

Introduces metals, metallurgy, and metalworking. Discusses the properties of metals, including mechanical properties. Examines several industrial manufacturing processes. Covers iron and standard steels. Explains the different kinds of heat treatment and their usage. Discusses some techniques of working with copper, aluminum, magnesium, titanium, lead, nickel, tin, and zinc. 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 Metals

Topics

Metals and Metallurgy; Properties of Metals; Internal Structure of Metals; Important Metals; Casting Metals; Metalworking; Joining Metals

Objectives

- Name five metals or alloys commonly used in industry.
- Name five mechanical properties of metals.
- Describe the uses of three metal alloys.
- Describe the metalworking processes of casting, forming, and machining.

Lesson 2: Properties of Metals

Topics

Mechanical Properties; Hardness; Ductility; Malleability; Toughness; Strength; Tensile Strength; Compression; Shear; Elasticity; Strain; Metal Fatigue; Thermal Expansion; Density; Specific Gravity

Objectives

- State the definitions of four mechanical properties of metals.
- Describe the three kinds of stress.
- List the ways in which a metal can fail.
- State the definition of elasticity.
- Demonstrate how to calculate the density of metal.

Lesson 3: Manufacturing Processes

Topics

Casting; Sand Casting; Permanent-Mold Casting; Centrifugal Casting; Die Casting; Forging; Extrusion; Powder Metal Forming; Sheet Metal Forming; Wire Drawing

Objectives

- Name four kinds of molds used in casting.
- List the steps in making a sand mold.
- Describe the differences between hot-chamber and cold-chamber die casting.
- Describe extrusion.
- List the steps involved in making a part by powder metallurgy.

Lesson 4: Iron and Steel

Topics

Iron Ore; Pig Iron; Smelting; Cast Iron; Gray Cast Iron; White Cast Iron; Malleable Cast Iron; Ductile Cast Iron; High-Alloy Cast Iron; Steel

Objectives

- Name the commercial grades of cast iron.
- List the important mechanical properties of commercial grades of cast iron.
- Describe the forms in which carbon appears in commercial grades of cast iron.
- Describe the process of smelting.

Lesson 5: Standard Steels

Topics

Carbon in Steels; Steel Rolling; Steel Classification; Spark Testing; Forms of Steel Stock; Hot-Rolled Plate and Sheet; Cold-Rolled Sheet; Steel Strip; Steel Plate; Steel Bars; Structural Steel; Alloy Steels; Stainless Steels

Objectives

- State the definition of steel.
- Name the method by which a steel was made, based on its AISI code.
- Demonstrate how to conduct a spark test.
- Identify steel sheets having as-rolled edges and cut edges.
- Describe two differences between alloy steels and steels containing only iron and carbon.

Lesson 6: Heat Treatment

Topics

Uses of Heat Treatment; Welding; Repairing Tools; Repairing Machines; Castings; Forgings; Carbon Content of Steels; Science of Heat Treatment

Objectives

- Describe the two basic processes, and state the four major purposes, of heat treatment.
- Explain why distortion and cracking occur during welding.
- Explain how to anneal, harden, and temper a star drill.
- State the definitions of low-carbon, medium-carbon, and high-carbon steels.

Lesson 7: Copper

Topics

Producing Copper; Copper Alloys; Machining Copper and Copper Alloys; Electrical Conductivity; Corrosion; Annealing Copper; Brasses; Muntz Metal; Admiralty Brass; Bronzes; Nickel Silvers; Aluminum Bronze; Beryllium-Copper Alloys; Cupro-Nickel Alloys; Copper Alloys for Casting

Objectives

- List the steps in producing copper from ore.
- List the contents of brass, Muntz metal, admiralty brass, bronze, nickel silver, aluminum bronze, and cupro-nickel.
- Describe dezincification in brass.
- Name the three groups of brasses, based on their zinc content, and the three categories of hardness.
- List the contents of red brass, and describe its uses.

Metals in the Plant

Lesson 8: Aluminum

Topics

Properties of Aluminum; Producing Aluminum; Aluminum Alloys; Wrought Aluminum Grades; Cast Aluminum Grades; Alloying Elements; Forming Processes; Anodizing; Welding Aluminum; Brazing Aluminum; Soldering Aluminum; Safety Precautions

Objectives

- List advantages and disadvantages of the oxide coating on aluminum.
- State the definition of wrought-grade and casting-grade aluminums.
- Describe the advantages of aluminum-silicon alloys.
- Describe how aluminum is anodized.
- Name the classifications of aluminum solders.

Lesson 9: Magnesium and Titanium

Topics

Producing Magnesium; Extracting Magnesium; Melting and Refining Magnesium; Alloying Magnesium; Magnesium Alloy Designation; Casting and Wrought Alloys; Extruding; Rolling and Forging; Machining; Joining Magnesium; Properties of Titanium; Uses of Titanium; Processing Titanium; Commercially Pure Titanium

Objectives

- Name the alloys of magnesium and titanium.
- List the useful properties of magnesium and titanium.
- Describe how to join magnesium alloys.
- Describe the precautions that must be taken when working with magnesium and titanium.
- Describe the uses of magnesium and titanium in industry.

Lesson 10: Lead, Nickel, Tin, and Zinc

Topics

Using Lead; Producing Lead; Properties of Lead; Forms of Lead; Fabricating Lead; Joining Lead; Using Nickel; Producing Nickel; Nickel Alloys; Using Tin; Producing Tin; Properties of Tin; Tinplate; Tin Alloys; Tin Solders; Babbitt; Bronze; Using Zinc; Producing Zinc; Machining Zinc

Objectives

- Describe the properties and characteristics of lead.
- List the properties that are improved by adding nickel to stainless steel.
- Describe how tinplate is manufactured.
- Describe how zinc is refined and processed.

Nonmetals in the Plant

Course 106: Nonmetals in the Plant

Describes properties, characteristics, and classifications of each material. Covers synthetic and natural materials. Examines various paints and coatings, their proper use, preparation, and application. Surveys industrial chemicals. Chemical safety precautions are covered, along with the proper use of protective equipment. 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 Nonmetals

Topics

Classifying Materials; Properties of Solids; Properties of Liquids; Behavior of Liquids at Rest; Properties of Gases; Behavior of Gases; Fluids in Motion; Mixed States of Matter

Objectives

- State the definition of a solid, a liquid, and a gas.
- Demonstrate how to change a liquid to a solid.
- Demonstrate buoyancy.
- Identify an object less dense than water, and an object more dense than water.
- List six possible combinations of matter.

Lesson 2: Plastics

Topics

Characteristics of Plastics; Processing Plastics; Molding; Casting and Foaming; Extruding; Reinforcing; Machining; Assembly; Welding; Patching

Objectives

- State the definition of a thermoplastic and a thermoset.
- Describe injection molding, foam molding, and extrusion.
- Select the best bonding agent for joining polyethylene parts.
- Describe the steps in patching a damaged area with glass-plastic material.

Lesson 3: Rubber

Topics

Nature of Rubber; Processing Rubber; Kinds of Rubber; Properties of Rubber; Vulcanizing Rubber; Uses of Rubber; Foam Rubber; Hose and Tubing; Tank Linings; Other Uses of Rubber; Reclaiming Rubber

Objectives

- Name four properties of rubber.
- Explain the vulcanizing process.
- Select the best hose for handling oils or gasoline.
- Describe how to use a pinhole locator.
- List the kinds of sheet rubber that should be kept on hand in the storeroom of an industrial maintenance department.

Lesson 4: Wood

Topics

Lumber; Properties of Wood; Wood Grades; Wood Defects; Measuring Lumber; Plywood; Plywood Grades; Choosing Wood; Wood Frame Construction; Wood Joints; Wood Preservation; Industrial Uses; Fasteners

Objectives

- State the definition of hardwood and softwood.
- Name the grades of softwoods and hardwoods.
- Describe a radial cut, a crosscut, and a tangential cut.
- Demonstrate how to calculate the number of board feet in a piece of 2 x 8 lumber 10 ft long.

Lesson 5: Construction Materials

Topics

Concrete; Mixing Concrete; Concrete Defects; Removing Stains; Masonry Units; Brick; Mortar; Patching and Repairing Masonry; Wallboard; Repairing Wallboard; Plaster; Glass

Objectives

- List the ingredients in concrete.
- State the definition of spalling, crazing, and dusting.
- Explain how to remove an oil stain from concrete.
- Demonstrate how to mix a small batch of mortar.
- List the steps in repairing a hole in wallboard.

Lesson 6: Insulating Materials

Topics

Heat Flow; Thermal Insulation; Loose-Fill Insulation; Blanket Insulation; Low-Density Insulation; Special Thermal Insulation; Acoustic Insulation; Vapor Barriers; Electrical Insulation; Fire Prevention

Objectives

- Name the ways by which heat can be transferred.
- State the formula for determining the thermal conductivity coefficient (k value) of a thermal insulator.
- Demonstrate how to install blanket insulation.
- Select the best materials for use an electrical insulation where resistance to flame and high temperature is important.
- List the safety rules that should be followed when working with insulating materials.

Lesson 7: Paints and Coatings

Topics

Protective Materials; Substrates; Paint; Primer; Choosing a Coating; Surface Preparation; Methods of Application; Using Colors; Special Coatings

Objectives

- List the factors to consider in selecting a protective coating.
- Name the qualities and characteristics of pigments and vehicles.
- List the safety precautions to follow when using paints containing solvent thinners.
- State the definition of primer.
- Demonstrate how to prepare a metal substrate for coating.

Nonmetals in the Plant

Lesson 8: Industrial Chemicals

Topics

Chemical Safety; Soaps and Detergents; Solvents; Acids; Packaged Chemicals; Aerosols; Oils; Refrigerants; Water-Treatment Chemicals; Welding and Plating Chemicals; Fuels; Fire-Fighting Chemicals; Protective Equipment

Objectives

- List the safety precautions to follow when working with liquid and solid chemicals.
- Name the general classifications of cleaning agents.
- Select the best acid for cleaning stainless steel and aluminum.
- State the reasons why aerosol spray cans are potentially dangerous.
- List considerations in selecting an oil for a particular use.

Lesson 9: Adhesives

Topics

Adhesive Terms; Kinds of Adhesives; Animal Glues; Casein Glues; Vegetable Glues; Synthetic-Resin Glues; Plastic Welding; Acrylic-Based Adhesives; Special Adhesives; Strength of Adhesives; Tapes; Special Tapes

Objectives

- State the definitions of adhesiveness, curing, drying, joint, pot, life, and tack.
- List the characteristics of thermosetting and themoplastic adhesives.
- Demonstrate the plastic-welding process.
- Select the best tapes for insulating and protecting electrical connections and wires.

Lesson 10: Carbon

Topics

Forms of Carbon; Properties of Carbon; Carbon Electrodes and Resistors; Carbon in Furnaces; Carbon Brushes; Kinds of Carbon Brushes; Industrial Diamonds; Fabricated Carbon Products; Chemical Uses of Carbon

Objectives

- List four uses of carbon and fabricated carbon products in industry.
- List three properties of carbon that make it useful in electrical and mechanical applications.
- Describe the carbon-arc welding process.
- List the most common causes of brush noise.
- Demonstrate the correct method of cutting individual rings from a continuous length of braided packing.

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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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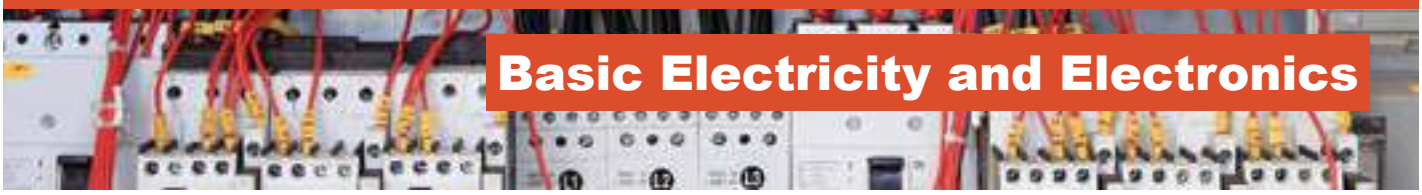

Basic Electricity and Electronics

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.

Transformers and AC Circuits

Course 203: Transformers and AC Circuits

Covers differences between DC and AC circuits. Explains AC sine wave, using vectors to solve AC problems, calculating impedance in circuits having inductance, capacitance, and resistance, AC power relationships in single-phase and three-phase circuits, and principles of transformer 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: Principles of Alternating Current

Topics

AC and DC Electricity; Waveforms; AC Waveform; Frequency; Peak-to-Peak Values; Average Values; Effective Values; Energy Storage; Faraday's Law; Basic Circuit Concepts

Objectives

- State of definition of a waveform.
- Demonstrate how to calculate the frequency of an alternator's output.
- Explain how to calculate an effective value.
- Name the kinds of values that must be used when applying the dc rules and laws to ac circuits.

Lesson 2: Mathematics in AC Circuits

Topics

AC Potential Difference; Angles and Degrees; Right Triangles; Vectors Applied to AC Circuits; Graphic Solutions; Mathematical Solutions; Calculating Instantaneous Values

Objectives

- Describe a triangle.
- State the definition of a vector.
- Identify the vector representing resistance in a vector diagram.
- Demonstrate how to calculate the total impedance in an ac circuit.

Lesson 3: Inductance and Inductive Reactance

Topics

Inductance; Factors Affecting Inductance; Counter Electromotive Force (CEMF); Inductive Reactance; Inductive Time Delay; Phase Angles; Calculating Impedance; Mutual Induction; Inductors in Series; Inductors in Parallel

Objectives

- Name the property of a coil that makes it resist changes in current.
- List the factors that determine inductance in a coil.
- State the definition of counter electromotive force.
- Demonstrate how to convert a frequency in Hz to a frequency in radians per second.

Lesson 4: Capacitance and Capacitive Reactance

Topics

How a Capacitor Works; Units of Capacitance; Factors Controlling Capacitance; Kinds of Capacitors; Discharging Capacitors; Series Capacitors; Parallel Capacitors; Time Constants; Capacitive Reactance; Phase Angle

Objectives

- Name the parts of a capacitor.
- List the factors that affect the amount of charge stored in a capacitor at a given potential difference.
- Demonstrate how to install a multisection electrolytic capacitor.
- State the definition of capacitive reactance.

Lesson 5: Impedance

Topics

Impedance in Series circuits; Phase Angles; Resonance in Series Circuits; Impedance in Parallel Circuits

Objectives

- State the definition of impedance.
- Explain how to calculate the impedance in a series ac circuit.
- Demonstrate how to find the value of a phase angle for a circuit.
- Explain how to calculate the impedance in a parallel circuit.

Lesson 6: Power and Energy in AC Circuits

Topics

Work and Energy; Power; Power in Resistive Circuits; Power in Inductive Circuits; Power in Capacitive Circuits; Importance of the Power Factor; Power Factor Correction; Power Capacitors; Capacitor Installation

Objectives

- State the definition of power.
- Demonstrate how to calculate power in an inductive circuit.
- State the reason why capacitors are added to circuits to increase the power factor.
- Explain how to install capacitors correctly.

Lesson 7: Three-Phase Circuits

Topics

Three-Phase Alternators; Y-Connected Alternators; Delta-Connected Alternators; Power in Three-Phase Circuits; Load Connections; Measuring Power in Three-Phase Circuits

Objectives

- List the main advantages of the three-phase ac system.
- State the definition of phase sequence.
- Demonstrate how to calculate the RMS power in a single-phase circuit.
- Explain how to measure the total power consumed by the load in a three-phase circuit.

Lesson 8: Principles of Transformers

Topics

Magnetic Field; No-Load Operation; Construction of Transformers; Variable Transformers; Transformer Losses and Efficiency; Autotransformers; Instrument Transformers

Objectives

- Explain the difference between the primary winding and the secondary winding in a transformer.
- Explain how the windings are positioned in a core-type transformer.
- List the kinds of losses that occur in transformers.
- State the definition of a current transformer.
- List the functions of an instrument transformer.

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Transformers and AC Circuits

Lesson 9: Transformer Applications

Topics

Transformer Designation; Transformer Insulation; Transformer Cooling; Transformer Polarity; Single-Phase Transformer Connections; Three-Phase Transformer Connections; Three-Phase Transformers; Installing Transformers

Objectives

- Name general kinds of transformers.
- List the temperature limits for each class of transformer insulation.
- Explain how oil-immersed transformers are cooled.
- Name the common methods of connecting three single-phase transformers for three-phase operation.
- Explain how to select the correct location for a transformer.

Lesson 10: Maintaining Transformers

Topics

Preventive Maintenance Program; Inspection; Making Transformer Inspections; Transformer Liquids; Dielectric Test; Breakdown Test; General Testing; Transformer Failure; Electrical Test; Disassembly and Inspection

Objectives

- Explain what to look for during an inspection of sealed transformers.
- List problems that are indicated by an increase in transformer operating temperature.
- Demonstrate how to perform a breakdown test.
- Explain how to locate the exact point of a leak in a welded joint below the liquid level.
- List the steps in inspecting a transformer when a winding fails.

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.

Three-Phase Systems

Course 208: Three-Phase Systems

Covers three-phase motor principles for induction, synchronous, and multi-speed dual-voltage motors. Gives recommended maintenance practices for large AC motors. Covers principles of three-phase motor starters, part winding, reversing, jogging, alternator principles and operation. Describes three-phase power distribution. 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 Three-Phase Motors

Topics

Induction Motors; Squirrel-Cage Rotors; Rotating Field; Pole-Phase Relationships; Development of Torque; Rotor Speed and Slip; Rotor Frequency; Rotor Resistance and Reactance; Rotor Current and Potential Difference; Power Factor of Induction Motors; Induction-Motor Torque; Variations in Torque

Objectives

- Describe a squirrel-cage rotor.
- List the factors that determine the strength of the magnetic field in an induction motor.
- Discuss pole-phase relationships.
- Demonstrate how to reverse the rotation direction of the magnetic field.
- Discuss the relationship between rotor speed and frequency.

Lesson 2: Induction Motors

Topics

Characteristics of Squirrel-Cage Motors; Stator Construction; Rotor Construction; Air Gap; Operating Features; Torque; Care of Stator Windings; Wound-Rotor Induction Motors; Brushes and Slip Rings; Wound-Rotor Characteristics; Wound-Rotor Maintenance; Applications of Wound-Rotor Motors; Maintaining Induction Motors

Objectives

- List the main parts of the stator.
- List operating characteristics of a wound-rotor motor.
- Demonstrate how to check rotor windings for short circuits.
- State the definition of a standard motor.

Lesson 3: Synchronous Motors

Topics

Characteristics of Synchronous Motors; Operating Principles; Synchronous Motor Fields; Starting Characteristics; Pull-In Torque; Effects of Slipping a Pole; Synchronous-Motor Applications; Power Factor of a Synchronous Motor; Improving the Power Factor; Brushless Synchronous Motors; Motor Efficiency and Care

Objectives

- List factors that contribute to the torque of an industrial synchronous motor during starting.
- Explain the effects of an amortisseur winding in a synchronous motor.
- State the definition of pull-in torque.
- State the reason why using synchronous motors can increase a low power factor in a plant.
- List the characteristics of brushless synchronous motors.

Lesson 4: Multispeed Motors

Topics

Multispeed Induction Motors; Consequent-Pole Motors; Consequent-Pole Motor Connections; Constant-Horsepower Motor Connections; Constant-Torque Motor Connections; Variable-Torque Motor Connections; Dual-Voltage Motor Connections; Y-Connected Dual-Voltage Motors; Delta-Connected Dual-Voltage Motors

Objectives

- Discuss the operating characteristics of multispeed induction motors.
- Select the best motor for driving equipment that requires the same torque at both high and low speeds.
- State the definition of a variable-torque motor.
- Explain the difference between a constant-horsepower motor and a constant-torque motor.

Lesson 5: Maintaining Three-Phase Motors

Topics

Maintenance Requirements; Cleaning Motors; Care of Stator Windings; Rotor Winding Care; Air Gap; Overload and Single-Phase Operation Problems; Motor Shaft Currents; Induction-Motor Bearings; Bearing Temperatures; Lubricating Motor Bearings; Maintenance Schedule

Objectives

- List the steps in measuring the resistance of the insulation on motor windings.
- Explain how to raise the temperature of a motor winding.
- List the steps in lubricating motor bearings.
- List the conditions that must exist before you can lubricate bearings.

Lesson 6: Motor Starters

Topics

The Need for Motor Starters; Electrical Limitations; Mechanical Limitations; Full-Voltage Starting; Typical Across-the-Line Starting; Methods of Reducing Starting Currents; Primary-Resistance Starter; Secondary-Resistance Starter; Reactor Starter; Part-Winding Starter; Y-Delta Starter; Synchronous-Motor Starters; Maintaining Motor Starters

Objectives

- Explain how a motor starter works.
- Explain the difference between open transition and closed transition.
- Name the common kinds of reduced-voltage starters.
- List the steps in inspecting motor starters.

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Three-Phase Systems

Lesson 7: Three-Phase Motor Controllers

Topics

Motor Starters; Circuit Protection; Multiple Start-Stop Control; Across-the-Line Reversing Starters; Plugging Control; Jogging; Controlling Surge and Backspin; Manual Compensator Starter; Magnetic Compensator Starters; Primary-Resistance Starters; Reactor Starters; Wound-Rotor Motor Starters

Objectives

- Explain how to select the best motor starter for a particular application.
- Explain the difference between low-voltage release and low-voltage protection.
- Describe the plugging process.
- Explain how to prevent backspin.

Lesson 8: Alternators

Topics

Alternator Characteristics; Three-Phase Alternators; Air Gap; Slip Rings; Exciters; Rating of Alternators; Alternator Windings; Effect of Current in the Armature; Voltage Regulation; Load Characteristics and Effects

Objectives

- Describe a three-phase alternator.
- Discuss the operating characteristics of alternators.
- List the characteristics that must be considered when you work on alternator windings.
- Name the causes of change in potential difference between terminals as the load changes.
- Demonstrate how to calculate three-phase power in an alternator.

Lesson 9: Auxiliary Generator Systems

Topics

Emergency Generator Requirements; Voltage-Control Equipment; Control Equipment; Manual Transfer Systems; Automatic Transfer Systems; Time-Delay Transfer; Safety Switches; Engine Protection; 400 Hz Generating Systems; General Characteristics; Controlling Potential Difference; Prime Movers and Output Control; 400 Hz Distribution; Maintenance Procedures

Objectives

- Explain how an automatic auxiliary generator works.
- List the methods of overcoming voltage-drop problems when starting loads.
- List the parts of a hydraulic starting system.
- State the definition of a prime mover.
- List the four guidelines to follow when troubleshooting or performing routine maintenance on generators.

Lesson 10: Power Distribution Systems

Topics

Distribution Voltages; Systems of 600 V or Less; Heat Losses; System Grounding; Benefits of System Grounding; Overcurrent Relay Protection; Overcurrent Relays with Voltage Control; Ground Relays; Phase-Sequence or Reverse-Phase Relays; Circuit-Opening Devices; Kinds of Protection; Selective Tripping; Cascade Tripping; Network Protection; Typical Small-Plant System; Distribution-System Testing

Objectives

- State the reasons why 240-volt systems are not as widely used as are 480-volt systems.
- Explain the difference between system grounding and equipment grounding.
- List the benefits of system grounding.
- Explain how an overcurrent relay works.
- Name common circuit-opening devices.

AC Control Equipment

Course 209: AC Control Equipment

Covers the broad range of industrial motor starting and control equipment, including NEMA sizes and ratings. Includes pushbutton control stations, limit switches, mercury switches, mechanical and magnetic plugging, foot switches, and pressure, temperature, and float switches. Covers control panel wiring and special applications. 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: Motor Starters

Topics

Selecting Motor Controls; Motor Controllers; Controller Enclosures; Starters; Manual Motor-Starting Switches; Magnetic Controls; Armature Assemblies; Magnetic Circuits; Shading Coil; Magnet Coils; Effects of Voltage Variation; NEMA Sizes for Magnetic Starters; AC Hum; Magnetic Starter Control Circuits; Auxiliary Contacts; Reversing Starters; Combination Starters

Objectives

- Describe the difference between a manual starter and a magnetic starter.
- Explain the function of a shading coil in a magnetic starter.
- Explain the effects of low voltage on a controller.
- State the reason why holding-circuit interlocks are required on magnetic starters and contactors.
- Demonstrate how to reverse the shaft rotation of a three-phase motor.

Lesson 2: Switches and Controls

Topics

Industrial Pushbuttons; Standard-Duty Pushbuttons; Selector Switches; Wall Boxes; Single-Contact Ratings; Heavy-Duty Pushbuttons; Contact Ratings; Pushbutton-Station Descriptions; Oiltight Pushbuttons; Pushbutton Operators; Selector-Switch Operators; Key-Operated Selector Switches; Illuminated Pushbuttons; Contact Blocks; Indicating Lights; Circuit Diagrams; Joy-Stick Operators; Assembled Pushbutton Stations; Legend Plates

Objectives

- Discuss the characteristics of industrial switches and controls.
- Identify the five most commonly used NEMA pushbutton stations.
- Demonstrate how to mount an oil-tight control station both vertically and horizontally.
- Explain the difference between standard and press-to-test indicating lights.
- Explain how a three-wire control circuit works.

Lesson 3: Limit Switches

Topics

Precision Snapswitches; Precision-Snapswitch Elements; Precision-Snapswitch Applications; Precision-Snapswitch Selection; Snapswitch Contact Arrangements; Snapswitch Operating Characteristics; Limit-Switch Contact Arrangement; Actuators for Limit Switches; Limit-Switch Enclosures; Mounting Limit Switches; Cam Design; Mercury Tilt Switches; Replacement of Mercury Switches; Failure of Mercury Switches

Objectives

- List the main parts of a precision snap-action limit switch.
- Describe the contact arrangement of a snapswitch.
- Describe the kinds of actuators used in limit switches.
- List the rules for the proper design and application of limit switch cams.
- Explain how a mercury switch works.

Lesson 4: Special Control Switches

Topics

Reversing Drum Switches; Foot Switches; Transfer Switches; Plugging Switches; Mechanical and Magnetic Plugging Switches; Selecting a Plugging Switch; Mechanical Pressure Switches; Bellows Pressure Switches; Diaphragm Pressure Switches; Piston Pressure Switches; Characteristics of Pressure Switches; Mechanical Temperature Switches; Float Switches

Objectives

- Explain how a drum switch works.
- Select the best switch for stopping a motor quickly.
- List the criteria for selecting a plugging switch.
- Identify different types of pressure switches.
- State the definition of pressure differential.

Lesson 5: Timers and Counters

Topics

Importance of Electromechanical Controls; Interval or Reset Timers; Reset-Timer Operation; Pushbutton-Start Interval Timers; Time-Delay Relays; Pneumatic Time-Delay Relays; Repeat-Cycle Timers; Pulse Timers; Percentage Timers; Impulse Counters; Electromechanical Counters; DC and AC Operation Counters; Time Totalizers; Revolution Counters; Programming Control

Objectives

- Explain how a reset timer works.
- Describe the different types of timers.
- Compare and contrast an electric counter and a time totalizer.
- Select the best control device for use where a machine cannot be controlled by time.
- Demonstrate how to set up a chart for a programed control circuit.

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AC Control Equipment

Lesson 6: Control Relays

Topics

Types of Relays; Operation of Relay Contacts; Relay Mountings and Enclosures; Relay Terminals; Relay Definitions; Time-Delay Relays; Voltage-Sensing Relays; Frequency-Sensing Relays; Phase-Sequence-Sensing Relays; Reed Relays; Kinds of Reed Relays; Operation of Reed Relays; NEMA Classes for Industrial Relays; Industrial Relay Construction; Causes of Relay Failures

Objectives

- State the definition of a relay.
- Explain the function of relay contacts.
- Select the best relay for use where large movement of the contacts or high contact force is required.
- List the advantages of a reed relay.
- Tell why industrial relays usually have double-break contacts.

Lesson 7: Equipment for Hazardous Locations

Topics

Enclosures for Hazardous Locations; Sources of Ignition; Combustion Principles; Evaluation of Hazardous Areas; Enclosures for Class I, Divisions 1 and 2; Switchgear and Industrial Controls; Lighting Fixtures; Motors and Generators; Plugs and Receptacles; Portable Equipment; Conduit for Class I Locations; Seals for Conduit Systems; Mineral-Insulated Cable; Armored Cable

Objectives

- List the requirements an enclosure must meet in order to be called explosion proof.
- List the characteristics of switchgear and industrial controls in hazardous conditions.
- List three situations in hazardous locations that require the use of seals.
- List the three basic conditions that can cause fire or explosion.
- Demonstrate how to terminate armored cable that enters an explosion proof housing.

Lesson 8: Special Motor Controls

Topics

Synchronous-Motor Control; Automatic Synchronous-Motor Control; Synchronous-Motor Control Units; Automatic Sequence-Accelerating Relays; Automatic Sequence-Decelerating Relays; Manual Autotransformer Starters; Automatic Autotransformer Starters; Part-Winding Starters; Primary-Resistance Starters; Multipoint-Resistance Starters; Y-Delta Starters

Objectives

- Name the two relays required for automatic starting of a synchronous motor.
- Explain how an automatic sequence-accelerating relay works.
- Select the best starter for use where the highest possible starting torque per ampere of line current is required.
- List the characteristics of different types of resistance starters.
- Describe a Y-delta starter.

Lesson 9: Motor Control Centers

Topics

Definition; Features and Advantages of MCCs; MCC Bus; NEMA Standards for MCCs; Construction Features of MCCs; NEMA Enclosures; NEMA Wiring; Circuit Protection; MCC Installation; Preoperation Checks

Objectives

- Define the term motor control center.
- Name the main advantages and disadvantages of back-to-back MCC construction.
- Explain how to install an MCC.
- Define a note, a caution, and a warning as each relates to MCC equipment.
- List the checks to conduct prior to releasing an MCC for plant operation.

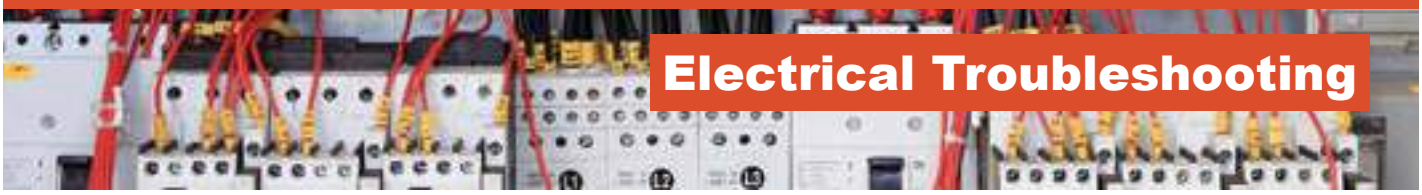
Lesson 10: Control Panel Wiring

Topics

Control-Panel Enclosures; Terminal Blocks; Wire Identification; Terminal Connections; Wire Connectors; Spring-Type Connectors; Pressure Connectors; Tap Connectors; Connector Markings; Wire Dressing

Objectives

- State the function of terminal blocks.
- Demonstrate how to make a terminal connection.
- Tell when to use different types of connectors.
- Describe the proper lacing of wires in a control panel.
- Explain when and how to use a wiring duct.



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.

Variable Frequency Drives

Course 212: Variable Frequency Drives

This Variable Frequency Drives course introduces students variable frequency drives and their applications in industrial plants and commercial buildings. Students learn how to improve VFD control and efficiency, troubleshoot and fix VFDs, reduce equipment downtime, and eliminate chronic VFD problems. Students who take this online course will learn to lower the cost of VFD operation.

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

Lesson 1: Basics for Understanding & Working with VFDs

Topics

Variable Frequency Drives; Becoming a Better Qualified Person when Working on VFDs; What is a Variable Frequency Drive; Basics for Understanding and Working with VFDs; Understanding Loads; Types of Torque; Other Load Considerations; Typical VFD Applications

Objectives

- Describe how a VFD operates.
- Identify the components of a VFD.
- Recognize the various torque demands on a VFD.
- Name typical VFD applications.

Lesson 2: Motors for VFDs

Topics

Basics of Motors; Induction Motor Rotation Basics; Three-Phase Motor Operation; Motor Speed and Number of Poles; Volts/Hz Ratio; Motor Nameplate Information; Recommended Maximum Insulation Temperature; The Inverter Duty Rated Motor

Objectives

- Explain the theory of AC motor operation.
- Understand the importance of Volts/Hz ratio.
- Describe the information on a motor nameplate.
- Recognize the importance of an inverter duty rated motor.

Lesson 3: VFD Data Input

Topics

Programming a VFD

Objectives

- Identify the components on a VFD keypad.
- Enter Motor Nameplate Data into a VFD.
- View the VFD parameters on the keypad display.

Lesson 4: Measurement and Safety for VFDs

Topics

Safety and VFDs; Test Equipment for VFDs; Making Safe Measurements

Objectives

- Identify OSHA safety standards.
- Use meters safely.
- Establish an electrical safe work condition.
- Choose the correct meter for troubleshooting VFDs.

Lesson 5: Hands-On Drive Exercises

Topics

Drive External Accessories; Drive Exercises

Objectives

- Review a schematic diagram for external VFD accessories.
- Connect indicator lights to an internal drive relay.
- Connect inputs for various desired control functions.
- Check the fault code register to determine the history of faults.

Lesson 6: Electronics for VFDs

Topics

3-Phase Rectification: The VFD “Front End”; Values Along the Sine Wave; The Diode Symbol; Checking Solid State Components in the Field; Full-Wave Bridge Rectifier; Ripple Voltage and Filtering; Types of Drives

Objectives

- Understand how an AC sine wave is generated.
- Explain the process of rectification.
- Identify semiconductor components.
- Describe pulse width modulation.
- Recognize basic drive types.

Lesson 7: Sizing and Selecting VFDs

Topics

Steps for Selecting a VFD; Sizing and Selecting VFDs; Key VFD Specs; Special Considerations

Objectives

- Create an equipment profile.
- Prepare a detailed analysis of performance requirements.
- Research either machine or process equipment history.
- Identify environmental conditions.
- Analyze the power distribution system.

Lesson 8: Installation and Startup of VFDs

Topics

Steps to Selecting a VFD; VFD Installation Requirements; Startup

Objectives

- Develop a checklist of items.
- Comply with manufacturer’s instructions and specifications.
- Identify with National Electrical Code® requirements.
- Verify proper overcurrent protection to drive.

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Variable Frequency Drives

Lesson 9: Troubleshooting VFD Systems and Motors

Topics

Troubleshooting 3 Phase Motors; Insulation Considerations for VFD Motors; Solutions Used to Prevent Motor Failures; Motor Bearing Issues for VFDs; Bearings; Resolving Bearing Problems; Troubleshooting VFDs; VFD Faults;

Objectives

- Troubleshoot three-phase motors.
- Identify motor failures.
- Discuss the six conditions needed to troubleshoot VFDs.
- Discuss a by-pass option.

Lesson 10: Preventative Maintenance

Topics

Preventive Maintenance: NETA Recommendations

Objectives

- Conduct a visual and mechanical inspection of the VFD.
- Perform electrical testing.
- Test the equipment grounding path.

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.

Power Transmission Equipment

Course 303.1: Power Transmission Equipment

Covers belt drives, chain drives, gears and gear drives, adjustable-speed drives, shaft alignment, shaft coupling devices, and clutches and brakes. Available with subtitles in Spanish. *Disponible con subtitulos en español.*

TPC Training is accredited by IACET to offer **0.8 CEU** for this program.

Lesson 1: Belt Drives

Topics

Uses of Belt Drives; V-Belts; Special V-Belts; Timing Belts; Flat Belts; V-Belt Sheaves; Timing-Belt Pulleys; Flat-Belt Pulleys; Variable-Speed Sheaves; Manually Adjustable Sheaves; Spring-Loaded Sheaves; V-Belt Installation

Objectives

- List the factors that affect the power transmitted by a belt drive.
- Name the main components of a belt drive.
- List the standard V-belt designations.
- Explain the reason for using group belts.
- Describe installation and replacement procedures for V-belts.

Lesson 2: Chain Drives

Topics

Chain Drives Compared to Belt Drives; Chain Drive Terminology; Roller Chains; Double-Pitch Chains; Leaf Chains; Silent Chains; Engineering-Class Chains; Cast Drive Chains; Sprockets; Chain Drive Installation

Objectives

- Explain the differences between chain drives and belt drives in transmitting power.
- Explain how a roller chain drive works.
- Describe the construction of offset roller chain.
- Explain the differences between sprocket types A, B, and C.
- List the steps in installing a chain drive.

Lesson 3: Gears

Topics

Gear Drives; Gear Definitions; Tooth Contour and Diametral Pitch; Spur Gears; Helical Gears; Single- and Double-Cut Gears; Herringbone Gears; Bevel Gears; Worm Gears; Maintenance

Objectives

- Define the following terms used to describe gear drives: pitch circle, pitch diameter, working depth, tooth face, tooth flank.
- Calculate the diametral pitch of a gear.
- List advantages and disadvantages of helical gears.
- Explain the differences between herringbone gears and double-cut helical gears.
- Define the following terms used in discussing worm gears: worm lead, worm lead angle, normal worm pitch, worm axial pitch.

Lesson 4: Gear Drives

Topics

Types of Gear Drives; Shaft-Mounted Gear Drives; Worm-Gear Drives; Miter-Gear Boxes; Gear Drive Installation; Gear Drive Maintenance; Gear Drive Definitions; Concentric-Shaft Gear Drives; Parallel-Shaft Gear Drives; Right-Angle-Shaft Gear Drives; Vertical-Shaft Gear Drives

Objectives

- Explain how additional speed reduction can be obtained with shaft-mounted gear drives.
- Describe a worm-gear drive and a miter-gear box.
- Give a general explanation of gear drive installation and maintenance.
- Define mechanical power, thermal power, and overload capacity.
- Explain what determines the service factor of a gear drive.
- Describe a concentric-shaft gear drive and a right-angle-shaft gear drive.
- Explain how parallel-shaft gear drives are lubricated.

Lesson 5: Adjustable-Speed Drives

Topics

Adjustable-Speed Drives; Belt-Type Adjustable-Speed Drives; Disk-Type Adjustable-Speed Drives; Roller-Type Adjustable-Speed Drives; Hydraulic Adjustable-Speed Drives; Electric Adjustable-Speed Drives

Objectives

- Identify the main criteria for selecting adjustable-speed drives for industrial plants.
- Explain the operation of a variable-speed belt drive.
- Describe how to control variable-speed drives.
- Describe the belts and chains used for variable-speed drives.
- Explain the operation of a roller-type variable-speed drive.

Lesson 6: Shaft Alignment

Topics

Need for Shaft Alignment; Geometry of Shaft Alignment; Preparing for Alignment; Reverse-Indicator Method; Aligning Multiple Machines; Face-Rim Alignment; Long-Span Alignment; Laser Alignment

Objectives

- Determine the corrections needed to align two machines, using the reverse-indicator method.
- Determine the corrections needed to align two machines, using the face-rim indicator method.
- Determine the corrections needed to align three machines on a common centerline.
- Determine the corrections needed to align two machines separated by a long floating shaft.
- State at least three advantages of using laser alignment equipment over using dial indicators.

Power Transmission Equipment

Lesson 7: Shaft Coupling Devices

Topics

Couplings in Industry; Coupling Characteristics; Solid Couplings; Jaw Couplings; Molded Rubber Couplings; Chain Couplings; Gear Couplings; Metal Disk Couplings; Metal Grid Couplings; Special Couplings; Shear-Pin Couplings; Torque-Limiting Couplings; Brake-Wheel Couplings; Floating-Shaft Couplings; Limited-End-Float Couplings; Spacer Couplings; Electrically Insulated Couplings; Torsionally Soft Couplings; Sheave-Mounted Couplings; Continuously Lubricated Couplings

Objectives

- List three functions usually performed by a coupling.
- Describe two types of jaw couplings.
- Name an application for molded rubber couplings.
- State an advantage of chain couplings.
- Explain the operation of a shear pin coupling.
- Describe a torque limiting coupling.
- Name an application that involves a floating shaft.
- Describe a limited end float coupling.
- List advantages and disadvantages of spacer couplings.

Lesson 8: Clutches and Brakes

Topics

Clutches as Couplings; Clutch Operating Methods; Jaw Clutches; Friction Clutches; Torque-Limiting Clutches; Tooth-Type Clutches; Centrifugal-Type Friction Clutches; Overrunning Clutches; Electric Clutches; Fluid Clutches; Dry-Charged Fluid Clutches; Brakes; Friction Shoe Brakes; Friction Disk Brakes; Electric Brakes

Objectives

- Explain the purposes of a clutch.
- Describe the operation of a friction clutch.
- Explain the need for overrunning clutches.
- Name at least one application for an electric clutch.
- Explain how a fluid clutch works.

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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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Piping Systems

Course 306: Piping Systems

Covers piping and tubing systems used for fluid transport in the plant: hydraulic fluids, steam, liquefied product, refrigerant, and water. Shows typical metallic and nonmetallic piping systems, pipe-joining methods, and how tubing and hoses differ from piping. Covers valves, pipe fittings, hangers, supports, and insulation. Shows how tubing is sized, fitted, bent, and joined. Explains uses of traps, filters, and strainers. 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 Piping Systems

Topics

Piping Systems; Fluids; Protecting Steam Lines; Keeping Fluids Clean and Moving; Piping Systems Maintenance; Valves and Fittings; Pipe Hangers and Supports; Temperature Effects; Piping Insulation; Typical Piping Systems; Maintenance Considerations

Objectives

- Describe what typical piping systems consist of, and explain their importance to plant operations.
- Identify common valves and fittings, pipe hangers and supports.
- Describe the effects of temperature on piping system components, and explain the need for insulation.
- List routine maintenance considerations for piping systems.

Lesson 2: Metal Piping

Topics

Pipes; Pipe Schedules; Other Pipe Codes; Types of Systems; Characteristics of Metals; Pipe-Manufacturing Methods; Behavior of Fluids in Piping; Piping Applications; Steam Piping; Water Piping; Maintenance Considerations; Joining Pipes

Objectives

- Explain how metal pipes are sized and designated according to standard codes and schedules.
- Identify the characteristics of metals that make them suitable for a variety of piping applications.
- Describe the different methods of connecting sections of metal pipe, including bell-and-spigot joints, welded, soldered, or brazed joints, screwed or threaded joints, and flanged joints.
- Discuss the major considerations involved in the maintenance of metal piping.

Lesson 3: Nonmetallic Piping

Topics

Nonmetallic Piping Materials; Clay Pipe; Concrete Pipe; Asbestos-Cement Pipe; Plastic Pipe; Limitations of Plastic Pipe; Joining Plastic Pipe; Maintaining Plastic Pipe; Glass Pipe; Other Piping Materials; Maintenance Requirements

Objectives

- Name the basic nonmetallic piping materials, and discuss the advantages and disadvantages of each.
- Identify the different forms of clay pipe and concrete pipe.
- Explain the difference between thermoplastic and thermosetting plastic pipe.
- Discuss the limitations of plastic pipe.
- Describe how to join sections of nonmetallic pipe, and how to maintain them.

Lesson 4: Tubing

Topics

Tubing; Advantages of Tubing; Tube Joining; Types of Tubing; Tubing Applications; Plastic Tubing; Other Applications; Tubing Maintenance

Objectives

- Compare piping and tubing, and list the major advantages of tubing.
- Describe the methods of cutting, bending, and joining sections of tubing.
- List the main types of metal tubing, and describe the kinds of industrial applications in which they are used.
- List the main types of plastic tubing, and describe the kinds of industrial applications in which they are used.

Lesson 5: Hoses

Topics

Hoses; Codes and Sizes; Hose Classifications; Hose Terminology; Reinforced Nonmetallic Hose; Nonmetallic Hose; Metallic Hose; Hose Couplings; Maintenance

Objectives

- Explain how hoses are sized, classified, and constructed.
- Define basic hose terminology.
- Discuss the respective advantages of metallic hose, nonmetallic hose, and reinforced nonmetallic hose.
- Describe the common types of hose couplings used in industrial service.
- List the primary maintenance requirements of hoses.

Lesson 6: Fittings

Topics

Functions of Fittings; Screwed Connections; Flanged Connections; Other Fittings; Welded Connections; Tube Fittings; Drawing Symbols

Objectives

- Discuss the main functions of fittings.
- Identify common pipe and tube fittings.
- Contrast screwed, flanged, and welded connections, and tell why one type of joint may be preferred for a given application.
- Explain how expansion joints and vibration dampeners work.
- Demonstrate a knowledge of the symbols used to represent joints and fittings on schematic drawings of piping systems.

Piping Systems

Lesson 7: Common Valves

Topics

Valves; Valve Construction; Valve Sizes and Functions; Types of Industrial Valves; Gate Valves; Globe Valves; Needle Valves; Ball Valves; Butterfly Valves; Plug Valves; Check Valves; Quick-Opening Valves; Valve Maintenance; Valve Connections

Objectives

- Explain the various ways in which valves control fluid flow in piping systems.
- Identify gate, globe, needle, ball, butterfly, plug, and check valves, and tell what each is used for.
- Explain how and why quick-opening valves are used in industrial piping applications.
- Describe routine inspection, lubrication, and maintenance procedures for common valves.

Lesson 8: Special Valves

Topics

Constructions and Materials; Diaphragm Valves; Blowoff Valves; Pressure-Regulating Valves; Temperature-Regulating Valves; Safety Valves; Relief Valves; Reducing Valves; Valve Operators; Magnetic Operators; Pneumatic and Hydraulic Operators; Remote Control

Objectives

- Explain how diaphragm valves work.
- Describe the functions of the three main types of blowoff valves.
- Tell how regulating valves, relief valves, and reducing valves are used in industrial piping systems.
- Describe how different kinds of actuators open and close valves in response to pneumatic, hydraulic, or electrical signals.

Lesson 9: Strainers, Filters, and Traps

Topics

General Applications; Strainers; Filters; Steam; Traps; Vent Valves; Trap Maintenance; Typical Piping System

Objectives

- Discuss the protective uses of strainers and filters in piping systems.
- Explain how the relationship between pressure and temperature affects steam lines, and creates the need for steam traps.
- Describe proper steam trap maintenance.
- Explain how and why air-vent and water-drain valves are used.
- Describe how a heat exchanger works in a fluid system.

Lesson 10: Accessories

Topics

Pressure Gauges; Temperature Gauges; Rotary Pressure Joints; Vacuum Breakers; Accumulators; Receivers; Actuators and Intensifiers; Pneumatic Pressure Line Accessories; Heat Exchangers; Wrenches; Maintenance

Objectives

- Describe how different types of gauges are used to measure pressure and temperature in piping systems.
- Explain why rotary pressure joints are necessary in some applications.
- Describe the functions of accumulators and receivers.
- Tell how actuators and intensifiers are used in fluid-power systems.
- Discuss the principles of preventive maintenance and repair maintenance as they apply to piping systems.

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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.

Hydraulic Troubleshooting

Course 308: Hydraulic Troubleshooting

Covers understanding the systems, using schematic diagrams, installation procedures, cleanliness and safety. Includes tubing cutting, bending, and flaring, identification and selection of proper fluid, and charging the system. Discusses planned maintenance, specific repair/replacement recommendations, system diagnosis, and troubleshooting. 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: Hydraulic Systems

Topics

Hydraulic Systems; Pumps and Their Drive Units; Actuators; Control Valves; Conductors and Connectors; Hydraulic Fluids; Fluid Storage and Conditioning Equipment; Tracing the System; Getting to Know the System; Circuit and System Diagrams; Cutaway Drawings; Mechanical Setup; Understanding Components; Convertible Components; System Operation

Objectives

- Name the six basic elements of a hydraulic system.
- Explain the functions of hydraulic pumps, actuators, control valves, conductors and connectors, hydraulic fluid, and fluid storage and conditioning equipment.
- Describe how to trace a system.

Lesson 2: Hydraulic Schematic Diagrams

Topics

Types of Hydraulic Diagrams; What is a Schematic?; Characteristics of Schematics; Lines; Symbols; What Kind of Schematic?; Guidelines for Reading Schematics; Look for Flow Patterns; Look for Guides; Read Diagrams Carefully; Read Symbols Carefully; Use the Step-by-Step Approach; Basic Elements of a Hydraulic System; Pumps; Actuators; Control Valves; Conductors and Connectors; Fluid Storage and Conditioning Equipment; A Hydraulic Circuit; Sequence-Valve Circuit

Objectives

- Name three basic types of hydraulic diagrams, and explain the purposes of each.
- Describe how a valve symbol is constructed.
- List the steps to follow when reading a schematic diagram.
- Identify common hydraulic symbols.

Lesson 3: Installing Hydraulic Components

Topics

Installation Considerations; Cleanliness; Installation Safety; Pump and Drive Installations; Pump Start-up; Control Valve Installation; Extra Valve Ports for Convenience; Valve Port Identification; Mechanical Valve Installation; Pneumatically Actuated Valves; Electrically Controlled Valves

Objectives

- Explain the importance of cleanliness in hydraulic installations.
- Describe possible consequences of neglecting safety precautions.
- Explain how motor and pump shafts are aligned before coupling.
- Explain the correct method for checking direction of pump rotation.
- List several useful hints for solenoid valve installation.

Lesson 4: Installing Pipes and Tubes

Topics

Installing Conductors and Connectors; Hydraulic Pipe; General Installation Procedures; Hydraulic Tubing; Tube Flaring; Checking the Flare; Tube Bending; Tubing Assembly; Hydraulic Hose; Hose Installation; Seal Installation; Reservoir Installation; Filter Installation; Cooler and Heat Exchanger Installation; Actuator Installation

Objectives

- Explain how pipe sizes are specified.
- Name the common types of pipe joints.
- List six important rules for good piping installation.
- Describe the advantages of hydraulic tubing over pipes.
- Describe the correct methods for bending and flaring tubing.
- List the key points for correctly installing hydraulic hoses, seals, reservoirs, filters, and actuators.

Lesson 5: Selecting Hydraulic Fluids

Topics

Hydraulic Fluid Selection; Lubricating Properties; Viscosity and Viscosity Index; Resistance to Chemical and Physical Changes; Low-Temperature Properties; Demulsibility; Antirust Properties; Fire Resistance; Compatibility; Fluid Selection; Filling the System; Filter Installation

Objectives

- List ten important properties of hydraulic fluids.
- Explain the difference between hydrodynamic and boundary lubrication.
- Explain what a fluid's viscosity index means.
- Define demulsibility and emulsibility.
- Describe how to read a viscosity-temperature chart.
- List the proper procedures for installing hydraulic fluid.

Lesson 6: Planning System Maintenance

Topics

Classifying Maintenance; Inspections; Organizing the Maintenance Plan; Maintenance Requirements; Regular Inspections; Reservoir Fluid Level; Reservoir Fluid Temperature; External Leaks; External Condition of System Structures; Operating Pressure; Fluid Quality; Filters; Machine Performance; Repair Planning; Reconditioning Planning; System Servicing; A Typical System Plan

Objectives

- List the major categories of hydraulic system maintenance.
- Name and describe the six essential items in a maintenance file.
- List the steps involved in reconditioning a hydraulic component.
- Explain how to set up a maintenance plan for a typical hydraulic system.

Hydraulic Troubleshooting

Lesson 7: Troubleshooting Systems

Topics

What is Troubleshooting?; Diagnosis and Symptoms; Evaluating Recent Maintenance History; Evaluating Symptoms; Determining the Cause; Providing the Solution; Tools and Gauges; Wrenches; Gauges; Typical Troubleshooting Application; Troubleshooting Charts

Objectives

- Describe the troubleshooting process.
- Explain how to evaluate recent maintenance history.
- List typical symptoms of common hydraulic system problems.
- Explain how to determine the cause of and provide a solution to a problem.
- Explain how a portable tester works.
- Describe how to keep and use troubleshooting charts.

Lesson 8: Troubleshooting Valves

Topics

Valve Problems; Valve Test Procedures; Repair Procedures; Disassembly; Cleaning; Inspection; Repair or Replacement; Inspection Troubleshooting; Solenoid Problems; Reassembly; Testing

Objectives

- Name five common valve problems and explain the sequence of steps to be followed in troubleshooting them.
- Describe the proper procedures for valve disassembly, cleaning, and inspection.
- Explain how to determine whether to repair or replace a malfunctioning valve.
- Describe the reasons for hydraulic “wire drawing.”
- List the reasons for electrical and mechanical failures of solenoid valves.
- Explain the procedures for reassembling, reinstalling, and testing valves.

Lesson 9: Troubleshooting Cylinders

Topics

Cylinder Descriptions; Troubleshooting a Cylinder; Cylinder Testing; Cylinder Repair; Cylinder Installation; Shock Absorbers

Objectives

- Name the most common types of hydraulic cylinders and identify their major parts.
- List the symptoms of internal and external cylinder misalignment.
- Explain what to do if you find internal leakage in a cylinder.
- Name the cylinder components most frequently replaced.
- Explain the purpose of a piston rod boot.
- Describe the symptoms of shock absorber failure.

Lesson 10: Troubleshooting Pumps and Motors

Topics

Pumps and Motors; Troubleshooting; Gear Pump Problems; Vane Pump Problems; Vane Motors; Axial-Piston Pump Problems; Radial-Piston Pump Problems; Pump and Motor Repair; Pump Maintenance Checks; Troubleshooting Chart (Pumps); Troubleshooting Chart (Motors)

Objectives

- List the proper procedures for troubleshooting pumps and motors.
- Name some common causes of pump failure.
- Describe typical causes of cavitation.
- Discuss the major sources of problems in gear pumps and vane pumps.
- Describe the effects of contaminants in axial-piston and radial-piston pumps.
- Explain the differences between a vane motor and a vane pump.

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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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Pneumatic Troubleshooting

Course 310: Pneumatic Troubleshooting

Covers pneumatic systems, schematic symbols and diagrams, installing system components, planned maintenance, system diagnosis, and troubleshooting. Includes maintenance of air compressors, control valves, air motors, electrical components, and hybrid 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: Pneumatic Systems

Topics

The Pneumatic System; The Air-Supply System; Reciprocating Compressors; Regulation and Control; Rotary Compressors; Cooling; Compressor Preventive Maintenance; The Delivered-Air System; Air-Line Filters; Air-Line Lubrication; Troubleshooting the Pneumatic System

Objectives

- Explain the operation of linear actuators—cylinders—in a typical pneumatic circuit.
- Describe the various types of compressors and how they work.
- Define intercooling and aftercooling.
- Describe basic preventive maintenance procedures for compressors.
- List the components of an effective delivered-air system and explain how they work together.
- Describe the three main types of air-line lubrication.

Lesson 2: Pneumatic Schematic Diagrams

Topics

Types of Symbols; How Schematic Symbols are Constructed; Diagraming an Air-Supply System; A Simple System; Timing Circuits; Safety Circuits; Symbols for Special Devices; System Schematics

Objectives

- Explain the different types of symbols used in pneumatic schematic diagrams—how they are constructed and what they show.
- Describe the operation of timing and safety circuits.
- Analyze the schematic diagram of a fluid-power system.

Lesson 3: Installation of System Components

Topics

The Compressor and Auxiliaries; Compressor Intakes; Compressor Foundations; Aftercoolers; Receivers; Dryers; Pipe Installation; Pipe Support; Pipe Threads; Tubing; Tubing Fittings; Hose Installation; Control Systems; Control-Valve Installation; Solenoid Coils; Cylinder Installation

Objectives

- Describe the proper installation of the compressor and its auxiliaries.
- Describe the installation of aftercoolers, receivers, and dryers.
- Explain the correct procedures for installing pipes, tubes, and hoses in pneumatic systems.
- Describe the installation of control valves, solenoid coils, and cylinders.

Lesson 4: System Maintenance

Topics

Planned Maintenance; Compressor Maintenance; System Maintenance; Control-System Maintenance; Tool Maintenance; Maintenance Logs and Records

Objectives

- Explain the concept of planned maintenance.
- Describe the basic procedures for maintaining the compressor and other important components in a pneumatic system.
- Describe the maintenance of industrial control circuit components.
- Explain the proper maintenance of pneumatic tools.
- Discuss the various types of maintenance logs and explain what kind of information is recorded in each.

Lesson 5: Determining System Failures

Topics

Understanding the System; Troubleshooting Procedures; Locating Troubles; The Operations Manual; Checking the Air Supply; Troubleshooting the Actuator; Checking the Control Valve; Checking a Control-Valve Actuator; Checking Sequence Valves; Checking Master Control Valves; Checking Interlocks; Making Final Adjustments; System Operation

Objectives

- List, in proper sequence, the steps to be taken in troubleshooting a pneumatic system.
- Name and describe the five important parts of every pneumatic system's operations manual.
- Describe procedures for troubleshooting the actuator.
- Explain how to check control valves, sequence valves, and interlocks.

Lesson 6: Troubleshooting Air Compressors

Topics

Cooling Reciprocating Compressors; Compressor Lubrication; Compressor Valves; Crankcase Ventilation; Piston Rings and Bearings; Control Systems; Rotary Compressors; Vane Compressors; Rotary-Screw Compressors; Centrifugal Compressors

Objectives

- Describe methods of cooling and lubricating reciprocating compressors.
- Explain the proper maintenance of compressor valves.
- Identify problems associated with the control system of a compressor.
- Describe the basic maintenance requirements of rotary, vane, rotary-screw, and centrifugal compressors.

Pneumatic Troubleshooting

Lesson 7: Troubleshooting Control Valves

Topics

Troubleshooting Controls; Troubleshooting a Circuit That Will Not Start; Checking Manual Overrides; Checking the Circuit Sequence; Checking for Locked Controls; Checking for Mechanical Interference; Electrical Solenoids; Checking an AC Solenoid; Checking a DC Solenoid; Troubleshooting Improper Sequence Operation; Improper Valve Shifting; Valves Shifting Without a Shift Signal; Changes in Control Timing; Miscellaneous Control-Element Problems; Lubrication Problems

Objectives

- Outline how to isolate a control malfunction in a pneumatic circuit.
- Explain how to troubleshoot a nonstarting or nonoperating circuit, improper sequencing of the circuit, and miscellaneous problems related to the equipment.
- Describe the proper procedures for checking electric solenoids.
- Explain how to check for problems related to valve shifting, control timing, and lubrication.

Lesson 8: Troubleshooting Cylinders

Topics

Cylinder Definitions; Cylinder Construction; Troubleshooting and Repair; Correct Cylinder Size; Adequate Air Pressure; Checking for Misalignment; Worn Packings; General Installation Techniques; Speed Controls

Objectives

- Define the different types of pneumatic cylinders.
- Describe the construction of a typical cylinder.
- Describe the proper procedures for troubleshooting cylinders, including checking for misalignment, worn packings, and adequate air pressure.
- Explain general installation techniques for cylinders and accessories.

Lesson 9: Troubleshooting Air Motors

Topics

Uses for Air Motors; Checking for Sufficient Air; Contaminated Air; Lubrication; Air-Motor Abuse; Hose and Clamp Maintenance; Air-Motor Troubleshooting; Vane Motors; Radial-Piston Motors; Axial-Piston Air Motors; Percussion Tools

Objectives

- Explain how to check for sufficient clean air when troubleshooting an inoperative air motor.
- Explain how to keep hoses, clamps, and couplings in good condition.
- Describe the operation and maintenance of vane, radial piston, and axial-piston air motors.

Lesson 10: Pneumatic/Hydraulic Systems

Topics

Air-Oil Tanks; Air-Hydraulic Boosters; Pressure Boosters; Single-Pressure Booster Systems; Dual-Pressure Booster Systems; Hydraulic-Control Cylinders; Fast-Advance Cylinders; Combined Air-Oil cylinders; Pneumatic Cushioning; Air-Hydraulic System Interlock; Pneumatic Servos; Troubleshooting Air-Oil Systems

Objectives

- Explain why and how compressed air and hydraulic pressure are combined.
- Describe the role of boosters in pneumatic/hydraulic systems.
- Explain how single-pressure and dual-pressure booster systems work.
- Describe the advantages and disadvantages of combined air-oil cylinders.
- Explain how pneumatic and hydraulic actions can be interlocked.
- Discuss the proper troubleshooting procedures for air-oil systems.

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Semiconductors

Course 251: Semiconductors

Describes semiconductor operation, various diodes, and transistors. Stresses proper environmental conditions, minimizing electrostatic discharge (ESD) and radio frequency interference (RFI). Discusses printed circuit board (PCB) and integrated circuit (IC) technology. Identifies semiconductor packages. Explains how to interpret manufacturers' spec sheets and analyze circuit performance by Q points and characteristics.

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

Lesson 1: Introduction to Semiconductors

Topics

Electron Flow and Semiconductors; Semiconductor Materials; Structure of Semiconductors; Semiconductor Doping; Conventional vs Electron Flow; Junction Diodes; Diode Characteristic Curves; Diode Specifications; Light-Emitting Diodes; Photoelectric Devices

Objectives

- Discuss the basic structure of a semiconductor atom and the movement of free electrons and holes.
- Discuss the purification and doping of semi-conductors.
- Describe the p-type region, n-type region, and junction of a pn junction diode.
- Discuss the characteristic curves and specification ratings of a diode.
- Describe the operation of a light-emitting diode, a photoconductive device, and a photovoltaic device.

Lesson 2: Environmental Conditions

Topics

Semiconductors and the Environment; Temperature Protection; Electrostatic Discharge (ESD); Controlling Static Electricity; Wrist Straps; Work Area; Static-Free Workstation; Tools and Techniques; Shipping and Receiving Semiconductors; Line Power Conditioning; Radio Frequency Interference (RFI); Electromagnetic Interference (EMI)

Objectives

- Discuss the importance of various environmental conditions to semiconductor operation.
- Discuss the effect of ESD on semiconductor devices and list several ways of preventing ESD in any work area.
- Discuss the requirements of a static-free workstation, and the proper techniques for using tools at the workstation.
- Describe ways to minimize ESD problems during packing and shipping.
- Explain how power conditioning prevents line power problems.
- Describe ways of preventing damage from radio frequency interference (RFI) and electromagnetic interference (EMI).

Lesson 3: Printed Circuit Boards

Topics

Printed Circuits; Printed Circuit Boards; Materials for Boards and Conductors; Single-Sided PCBs; Double-Sided PCBs; Multilayer PCBs; Mounting Components; Surface Mount Technology; Soldering; PCB Connectors; Mounting PCBs; Repairing PCBs; PCB Surface Contamination and Corrosion

Objectives

- Discuss the advantages of PCBs over direct wiring.
- Explain why both flexible boards and rigid boards are used for printed circuits, and discuss the advantages and disadvantages of each.
- Explain how single-sided, double-sided, and multilayer boards are made.
- Describe the three classes of surface mount assemblies.
- Compare various soldering methods and discuss the advantages and disadvantages of each.
- Describe PCB connectors and mountings.
- Discuss PCB repair techniques and limitations.

Lesson 4: Transistors and Integrated Circuits

Topics

Purpose of Transistors; Structure of Transistors; Schematic Symbols; Performance Curves; Transistor Connections; Transistor Characteristics; Transistor Specifications; Transistor Switching; Integrated Circuits; Classifying ICs by Structure; Classifying ICs by Function; Other IC Classifications

Objectives

- Describe the differences between an npn transistor and a pnp transistor and identify the schematic symbol for each.
- Discuss transistor performance in the active region, saturation region, and cutoff region.
- Explain how the three kinds of transistor connections affect circuit values.
- Discuss four common transistor characteristics.
- Discuss various ways of classifying integrated circuits.

Lesson 5: Packages and Performance Analysis

Topics

Semiconductor Packages; Lead Identification; Mounting Components on Chassis and PCBs; Replacement Methods; Manufacturers' Data Sheets; Maximum Ratings; Electrical Characteristics; Transistor Operating Points; Analysis of Characteristics

Objectives

- Describe several kinds of semiconductor packages.
- Explain how to identify leads.
- Describe methods for mounting components on PCBs and chassis.
- Explain how to use manufacturers' data sheets.
- Discuss the analysis of circuits by Q points and by characteristics.

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Power Supplies

Course 252: Power Supplies

Covers the four basic kinds of power supply conversions. Explains how to work with nonchemical cells as well as primary and secondary cells of various materials. Describes in detail the functions and operation of several kinds of rectifiers, filters, and voltage regulators and explains how they work together as power conditioners. Discusses basic tools, test devices, and procedures for troubleshooting.

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

Lesson 1: Power Supplies and Power Conditioners

Topics

Functions of Power Supplies and Power Conditioners; AC-to-DC Power Supplies; AC-to-AC Power Supplies; AC-to-DC Power Supplies (Rectifiers); DC-to-AC Power Supplies (Inverters); Inverter Feedback Circuits; Power Conditioners; Safety Precautions

Objectives

- Discuss the basic functions of power supplies and power conditioners.
- Describe dc-to-dc, ac-to-ac, ac-to-dc, and dc-to-ac power supplies.
- Compare the operation of transformer-driven and oscillator-driven inverters.
- Discuss the functions of filters, voltage regulators, voltage dividers, switching power supplies, zand ferroresonant power supplies.
- Explain why low voltages can be dangerous.

Lesson 2: Cells and Batteries

Topics

Cells and Batteries; Electrochemical Cells; Kinds of Chemical Cells; Primary Cells; Secondary Cells; Lead-Acid Cells; Nickel-Cadmium Cells; Nickel-Metal-Hydride Cells; Nickel-Iron Cells; Maintenance of Chemical Cells; Hazards and Precautions; Nonchemical Cells; Cell and Battery Development

Objectives

- Explain the difference between a battery and a cell and identify symbols for each.
- Describe the parts of an electrochemical cell.
- Compare the characteristics and uses of Leclanché, high-energy, and alkaline carbon-zinc cells.
- Discuss battery-recharging problems and explain how to check for overcharging.
- Discuss ways to maintain and dispose of chemical cells and batteries safely.
- Discuss the use of five kinds of nonchemical energy sources and recent developments in cells and batteries.

.Lesson 3: Rectifiers

Topics

Diode Rectifiers; Diode Ratings; Parallel Diodes; Series Diodes; Silicon-Controlled Rectifiers (SCRs); Half-Wave Rectifiers; Full-Wave Rectifiers; Bridge Rectifiers; Three-Phase Rectifiers; Voltage Multipliers

Objectives

- Define the term rectifier.
- Explain how to interpret diode ratings on a manufacturer's specification sheet.
- Compare the effects of connecting diodes in parallel and in series.
- Describe the operation of a silicon-controlled rectifier.
- Compare the operation of half-wave and full-wave rectifiers.
- Discuss the operation of bridge and three-phase rectifiers and explain how voltage multipliers work.

Lesson 4: Filters

Topics

Kinds of Filters; Filters and Circuits; Ripple; Circuit Components; Kinds of Power Supply Filters; Bleeder Resistors; Bypass Filters; Input Filters

Objectives

- Name several kinds of filters used in power supplies.
- Discuss the effects of ripple and describe ways ripple is measured.
- Discuss the use of capacitors, inductors, and resistors in filter circuits.
- Compare the advantages and disadvantages of capacitance, inductance, RC, and LC power supply filters.
- Explain why capacitor power supplies should include bleeder resistors.
- Discuss the uses of bypass filters and input filters.

Lesson 5: Voltage Regulators

Topics

Voltage Regulators; Shunt Regulators; Series Regulators; Integrated Circuit (IC) Regulators; Switching Regulators; Primary Circuit Regulators

Objectives

- Discuss the purposes of voltage regulators in power supplies.
- Explain the function of the control circuit and the current limiting circuit in series voltage regulators.
- Discuss the advantages of IC voltage regulators.
- Describe the operation of switching regulators and explain how it differs from that of other kinds of regulators.
- Discuss the use of SCRs and triacs in primary circuit regulators.

Lesson 6: Troubleshooting Power Supplies

Topics

General Troubleshooting Approach; Preliminary Checks; Power-Off Visual Inspection; Power-Off Fuse Tests; Power-On Tests; Output Tests; Section Tests and Part Tests

Objectives

- Discuss at least five kinds of test equipment and tools used to troubleshoot power supplies.
- Describe the three main steps in troubleshooting a power supply.
- Describe the basic procedures for preliminary checks and power-off visual inspection and fuse tests.
- Describe the basic procedures for power-on tests and output tests.
- Explain how to perform section tests and part tests.

Amplifiers

Course 253: Amplifiers

Covers the effects of gain, bandwidth, and distortion on performance. Compares linear and nonlinear amplifiers. Explains using transistor curves to analyze amplifier operation by region, load line, operating (Q) points, and biasing. Discusses impedance matching, comparing capacitive, transformer, and direct-coupled amplifiers. Provides methods for troubleshooting common amplifier problems.

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

Lesson 1: Introduction to Amplifiers

Topics

Amplifying Circuits; Amplifier Characteristics; Transistor Amplifiers; Transistor Characteristic Curves; Effects of Temperature; Operational Amplifiers; Switching Amplifiers

Objectives

- Explain how gain, bandwidth, and distortion relate to amplifier operation.
- Compare bipolar transistor amplifiers and FET amplifiers.
- Explain how to use characteristic curves to predict transistor performance.
- Explain how to use an input/output curve to determine transistor gain.
- Discuss the effect of ambient temperature on amplifier performance.
- Discuss the uses of operational amplifiers and switching amplifiers.

Lesson 2: Single-Stage Amplifiers

Topics

Operating Region; Biasing Circuits; Operating Points and Load Lines; Biasing Common-Emitter Amplifiers; Biasing Common-Collector and Common-Base Amplifiers; Biasing Field-Effect Transistor Amplifiers; Amplifier Classifications; Push-Pull Amplifiers

Objectives

- Discuss the transistor characteristics that define operating region limits.
- Explain how to draw an amplifier load line.
- Explain how to find the operating point of an amplifier.
- Discuss biasing as a means of establishing a stable operating point in an amplifier circuit.
- Discuss five ways that amplifiers can be classified and compare Class A, AB, B, and C amplifiers.

Lesson 3: Amplifier Performance and Multistage Amplifiers

Topics

Amplifier Performance; Power Gain and Amplifier Efficiency; Current Gain; Voltage Gain; Distortion; Impedance Matching; Multistage Amplifiers; Multistage Amplifier Gain; Multistage Amplifier Bandwidth; Amplifier Coupling; Capacitive Coupling; Transformer Coupling; Direct-Coupled Amplifiers

Objectives

- Explain how to calculate amplifier power gain, efficiency, current gain, and voltage gain.
- Explain how nonlinearity and clipping cause amplifier distortion.
- Discuss the importance of impedance matching in interconnecting circuits.
- Explain how to calculate multistage amplifier gain and bandwidth.
- Compare the advantages and disadvantages of capacitive-coupled, transformer-coupled, and direct-coupled amplifiers.

Lesson 4: Op Amps

Topics

Differential Amplifiers; Typical Op Amp; Inverting Amplifiers; Summing Amplifiers; Noninverting Amplifiers; Op Amp Frequency Effects; Nonlinear Op Amp Circuits; Integrators; Comparators; Squaring Circuits

Objectives

- Describe the operation of differential amplifiers.
- Compare the properties of an ideal op amp and a typical actual op amp.
- Describe the operation of inverting amplifiers in terms of virtual ground.
- Compare the advantages of inverting amplifiers and noninverting amplifiers.
- Explain how integrators and comparators work.
- Explain how zener diodes are used in squaring circuits.

Lesson 5: Troubleshooting Amplifiers

Topics

Troubleshooting Single-Stage Amplifiers; Troubleshooting by DC Analysis; Troubleshooting by AC Analysis; Troubleshooting Three-Stage Amplifiers; Troubleshooting Trees; Troubleshooting Procedures; Measuring Gain; Measuring Power Supply Performance; Troubleshooting Components; Troubleshooting Operational Amplifiers

Objectives

- Describe basic procedures for troubleshooting single-stage and multistage amplifiers.
- Explain how dc analysis, ac analysis, and troubleshooting trees are used in amplifier maintenance.
- Explain how to measure amplifier gain and power supply performance.
- Describe the procedures for troubleshooting resistors, capacitors, and op amps.

Oscillators

Course 254: Oscillators

Covers how oscillation is started and maintained. Compares sine-wave oscillators and square-wave switching circuits. Discusses monostable, astable, and bistable flip-flop operation;Schmitt trigger circuits, frequency dividers, ripple counters, propagation delays, and glitches. Describes operation of low-, high-, and band-pass filters; and, how to troubleshooting oscillator components and circuits.

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

Lesson 1: Introduction to Oscillators

Topics

Oscillation; Oscillators and Amplifiers; Classes of Oscillators; LC (Tuned) Circuits; RC (Phase-Shift) Oscillators; Crystal Oscillators; Comparison of Oscillators; Common Oscillator Circuits

Objectives

- Describe the conditions needed to start and to sustain oscillation.
- Explain how positive feedback affects oscillation.
- Name three kinds of feedback networks used in oscillators.
- Discuss the advantages and disadvantages of tuned circuits, phase-shift oscillators, and crystal oscillators.
- Describe several common oscillator circuits.

Lesson 2: Flip-Flops

Topics

Square Waves; Switching Circuit; Kinds of Flip-Flops; One-Shots; Integrated Circuit (IC) One-Shots; Astable Flip-Flops (Multivibrators); Frequency of Multivibrators; IC Astable Circuit from One-Shots; Bistable Flip-Flops; IC Bistable Flip-Flops

Objectives

- Discuss the differences between sine wave oscillators and square wave switching circuits.
- Explain how rise time and the time constant affect flip-flop circuits.
- Compare the operation of discrete transistor one-shots and IC one-shots.
- Explain how IC pairs of one-shots or IC op amps form an astable multivibrator.
- Describe the operation of bistable flip-flops.

Lesson 3: Logic Clocks

Topics

Combinational Logic; Synchronous Logic; Logic Clock Generation; Negative Resistance Oscillator; Integrated Circuit (IC) Oscillator; Clock Conditioning; Schmitt Trigger Circuit; Frequency Dividers; Multiphase Clocks; Real-World Logic Clocks

Objectives

- Compare combinational logic, synchronous logic, and sequential logic.
- Explain how logic clocks are generated.
- Explain how negative resistance enables the UJT relaxation oscillator to be used as a logic clock.
- Discuss the effect of hysteresis on logic clock operation and describe the operation of the Schmitt trigger circuit.
- Describe the operation of ripple counters and other frequency dividers.
- Discuss problems caused by real-world (nonideal) logic clocks.

Lesson 4: Filters and Waveforms

Topics

Filters in Wave Shaping; Simple Filters; RC Low-Pass Filters; RL Low-Pass Filters; High-Pass Filters; Band-Pass Filters; Band-Reject Filters; Active Filters; Time Constants; Universal Time Constant Chart; Differentiators and Integrators; Function Generators

Objectives

- Discuss the composition of waveforms and explain how filters change the shapes of waveforms.
- Compare the frequency characteristics of low-pass and high-pass filters and of band-pass and band-reject filters.
- Discuss the calculation of time constants in timing circuits.
- Describe methods of creating and shaping complex waveforms, including the differentiator and integrator circuits.
- Explain briefly how digital waveforms are generated with a microprocessor.

Lesson 5: Troubleshooting Oscillators

Topics

Test Equipment; Troubleshooting Components; Troubleshooting Circuits; Troubleshooting Oscillators; Tracing Oscillator Operation; Troubleshooting Multivibrators; Troubleshooting One-Shots; Troubleshooting Bistable Flip-Flops; Troubleshooting Sequential Logic Circuits; Troubleshooting Clocks; Troubleshooting Frequency Dividers; Troubleshooting Filters

Objectives

- Discuss the basic requirements of four kinds of equipment used to test oscillators.
- Describe good general practices in troubleshooting oscillator components and circuits.
- Describe the steps in tracing oscillator circuit operation and selecting test points for monitoring waveforms.
- Discuss the steps in troubleshooting multivibrators, one-shots, and flip-flops.
- Discuss troubleshooting methods for sequential logic circuits, including clocks.
- Discuss troubleshooting methods for frequency dividers and filters.

Digital Logic Systems

Course 291: Digital Logic Systems

Compares analog and digital switching circuits. Explains Boolean logic functions. Describes TTL and CMOS logic, and IC logic devices. Explains how flip-flops, clock circuits, counters, multiplexers, and memory circuits work. Describes sections and interfaces in functional logic systems, including microprocessors. Describes proper methods for detection and correction of common fault potentials.

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

Lesson 1: Digital Logic Fundamentals

Topics

Digital Logic; Boolean Algebra; Logical AND Function; Logical OR Function; Logical NOT Function; Digital Applications; Solid-State Switches; Positive and Negative Logic; NAND Logic; Combining Logic Circuits; TTL Logic; Integrated Circuit (IC) Logic Devices; 7400 Series TTL Logic; CMOS Logic

Objectives

- Explain the difference between digital and analog circuits.
- Describe AND, NOT, and OR logic functions.
- Explain how solid-state switches can perform logic functions.
- Compare equivalent NAND and NOR gates using positive and negative logic.
- Discuss the importance of TTL and CMOS circuits.

Lesson 2: Logic Building Blocks

Topics

Sequential Logic; Flip-Flops; Clocked Flip-Flops; Clock Circuits; Schmitt Triggers; Frequency Dividers; Pulse Counters; Decimal and Binary Number Systems; Other Number Systems

Objectives

- Describe the function of a logic clock.
- Explain the operation of a flip-flop.
- Discuss the differences among clocked R-S flip-flops, D-latches, and J-K master-slave flip-flops.
- Explain how to convert between the decimal and binary number systems.
- Discuss the use of BCD and the octal and hexadecimal number systems.

Lesson 3: Medium- and Large-Scale ICs

Topics

Integrated Circuits Defined by Size; Counters; Serial vs Parallel Data Transmission; Registers; Multiplexers; Decoders/Demultiplexers; Arithmetic Circuits; LSI Memories

Objectives

- Explain the operation of each of the following counters: ripple, BCD, synchronous, and up/down.
- Describe the operation of a shift register.
- Discuss the difference between multiplexers and decoders/demultiplexers.
- Define the terms read, write, serial access, and random access as they apply to memories.
- Discuss the purposes of RAM and ROM devices.

Lesson 4: Functional Logic Systems

Topics

Logic System Basics; Logic Subsystems; ROM Logic Subsystems; Microprocessors; Input/Output (I/O) Subsystems; Noncontact Switches; Multiple-Bit I/O Devices; Data Codes; Data Displays; Data Transfer

Objectives

- Describe the sections of a basic logic system.
- Compare a ROM, a PROM, and a PLA.
- Name the basic parts of a microprocessor.
- Describe common kinds of I/O interfaces and data displays.

Lesson 5: Troubleshooting Logic Systems

Topics

Reliability of Solid-State Components; External Faults; General Troubleshooting Practices; Gathering Information; Isolating the Problem to a Major Subsystem; Localizing the Trouble; Interpreting Logic Diagrams; Timing Waveforms; Locating Faulty Components; Test Equipment

Objectives

- Describe seven external faults that can affect solid-state circuits.
- List the major steps in efficient troubleshooting.
- Name information sources for identifying system malfunctions.
- Explain how to trace a faulty component by using a troubleshooting tree.
- Explain how to use various kinds of test equipment to pinpoint system faults.

Energy Conservation Basics

Course 376: Energy Conservation Basics

Covers energy sources and the history of energy usage. Examines alternative energy sources and their feasibility. Identifies current energy usage patterns and places where energy can be conserved. Explains how to recognize energy waste, and includes sample corrective actions. Explains how to conduct an energy survey.

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

Lesson 1: Energy and its Sources

Topics

What is Energy?; How Fossil Fuels Developed; Mining and Drilling Methods; Putting Fossil Fuels to Work; Nuclear Power; Nuclear Reactors; Solar Energy; Converting Solar to Electrical Energy; Wind as an Energy Source; Hydroelectric Power; Evaluating Energy Sources; Measuring Energy

Objectives

- Define energy and list several potential energy sources
- Explain how fossil fuels developed and how they are extracted from the earth.
- Explain, in simple terms, how uranium produces energy.
- List at least one advantage and one disadvantage of each of the following: oil, natural gas, coal, solar power, wind energy, and hydroelectric power.
- Tell how heat and temperature are measured (what units).

Lesson 2: Why the Energy Crisis?

Topics

History of Energy Use; The Fossil Fuel Age Begins; America Strikes Oil; Other Traditional Sources; How Much Energy is Enough?; WWII and After; The End of Cheap Oil; World's Energy Record; Fossil Fuel Reserves; Increase in Coal Use; Fossil Fuels Produce More Than Energy; Alternative and Synthetic Fuels; Gas and Oil from Coal; Nuclear Fuels; Nuclear Fusion; Geothermal Energy Sources; Biomass

Objectives

- Define the fossil fuel age and list the energy sources that made it possible.
- Name some of the factors that contributed to the greatly increased use of fossil fuels in the past century.
- Describe the outlook for fossil fuel availability in the next century.
- Give examples of current efforts to develop alternative sources of oil and gas.
- Identify potential sources of future energy and describe their present limitations.

Lesson 3: Energy Consumption and Loss

Topics

Using Fuels to Generate Electricity; Fuels Most Often Used; Energy Losses in Consumer Areas; Effects of Climate on Energy Use; Degree-Days; Cooling Degree-Days; Using Degree-Day Figures; Where Can Energy Be Conserved?; More Savings; The Cost of Saving Energy; ROI and Payback Period; Establishing Priorities

Objectives

- Tell why generating electricity is an inefficient use of energy and what characteristics of electricity justifies this inefficiency.
- Compare energy use in the three categories of energy consumers.
- Explain degree-days and how they are used?
- State why a building's HVAC system is a good place to start looking for potential energy savings.
- Tell how to calculate the payback period of an energy conservation plan.

Lesson 4: Practical Conservation Measures

Topics

Recognizing Energy Waste in Building Structures; Correcting Energy Waste in Building Structures; Energy Loss in Heating and Cooling; Sample Heating/Cooling Corrective Measures; Energy Waste in Mechanical Systems; Some Energy Savers for Mechanical Systems; Recognizing Electrical Energy Waste; Electrical Conservation Examples; Electric Utility Charges; Computer Monitoring and Control

Objectives

- Recognize energy waste conditions in building structures.
- Name at least three factors that affect boiler and furnace efficiency.
- Give examples of energy waste in a building's mechanical system and how it might be eliminated.
- Explain peak demand and why it is important in electricity costs.
- Tell how computer monitoring and control can be used to save energy and lower utility costs.
- Tell how computer monitoring and control can be used to save energy and lower utility costs.

Lesson 5: Conducting an Energy Audit

Topics

What Is an Energy Audit?; Mini-Audits; Tools Required for the Energy Survey; Sample Energy Audit; Fuel Usage Information; Building and Equipment Data; Conservation Opportunities; Priorities

Objectives

- Name and describe the six segments of a detailed energy audit.
- Define a mini-audit and tell when it might be used.
- List the tools required for an energy survey of any building.
- Record the data necessary to make up an energy audit.
- Explain the procedure for assigning priorities to energy-saving projects.

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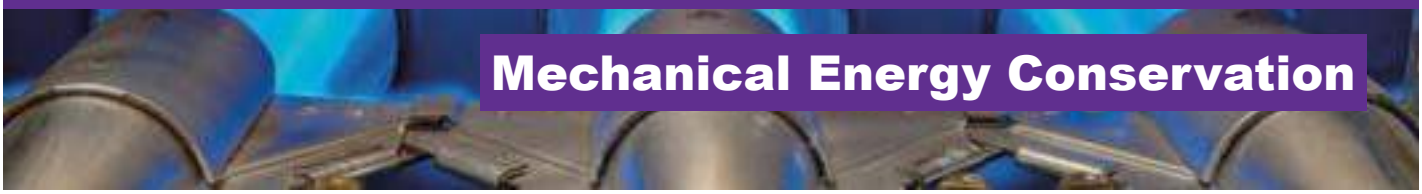

Mechanical Energy Conservation

Course 379: Mechanical Energy Conservation

Covers causes and effects of friction and the importance of lubrication. Includes a discussion of efficient operation of materials handling systems, elevators, and escalators. Examines ways to conserve energy by reducing vibration. Explains importance of good maintenance of pumps, blowers, and compressors. Discusses vehicle efficiency, emphasizing tuneups, lubrication, and other energy-saving practices.

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

Lesson 1: Reducing Friction

Topics

Mechanical Systems; Prime Movers; Mechanical Power Transmission; Mechanical Efficiency; Friction; Coefficient of Friction; Reducing Friction; Lubrication; Gear and Bearing Oils; Greases; Seals; Manual Lubricating Devices; Natural Oil Lubrication Systems; Pressurized Oil Lubrication; Automatic Oil Lubricating Devices; Automatic Grease Lubrication Systems; Lubrication Precautions

Objectives

- Name the three basic parts of a mechanical system
- Explain the concept of mechanical efficiency.
- Give examples of the three basic kinds of friction encountered in mechanical systems.
- List at least four purposes of lubrication.
- Define viscosity, viscosity index, and pour point.
- Tell why oil and grease seals are used.

Lesson 2: Cutting Transmission Losses

Topics

Belt Drives; Chain Drives; Gear Drives; Bearings; Clutches and Brakes; Drive Couplings; Vibration; Balancing Machinery; Vibration Isolation; Vibration Switches

Objectives

- Explain why proper bearing lubrication is important.
- Name the drive component responsible for the most power loss.
- List three functions of couplings.
- Show how to check coupling alignment.
- Define vibration and explain why vibration control is important.
- Compare and contrast static unbalance and dynamic unbalance.

Lesson 3: Pumps, Fans, and Compressors

Topics

Pump Installation and Piping; Priming; Bearing Lubrication; Seals and Packing; Centrifugal Pumps; Vertical Turbine Pumps; Rotary Pumps; Reciprocating Pumps; Problems With Fans and Blowers; Improving Fan Performance; PM for Fans; Compressor Operation; Compressor Maintenance

Objectives

- Tell why proper pump installation is important to energy conservation.
- Describe the problems that can occur if pump bearing lubrication is neglected.
- Demonstrate the proper method of replacing pump packing.
- List the three major maintenance items related to centrifugal pumps.
- Identify several places where energy losses can occur in a fan system.
- Explain how to determine whether a fan is suited to the system in which it is operating.
- Name several maintenance procedures important to efficient compressor operation.

Lesson 4: Elevators and Conveyor Systems

Topics

Drive Packages; Conveyor Operation; Overhead Conveyors; Belt Conveyors; Roller Conveyors; Escalators; Elevators; Elevator Maintenance; Elevator Safety; Loading Docks

Objectives

- List at least two energy-saving tips to keep in mind when dealing with conveyor operation.
- Explain the purpose of a take-up in a conveyor system.
- Differentiate between unit-handling belt conveyors and bulk-handling belt conveyors.
- Tell how lagging can reduce energy waste.
- Name one type of conveyor that is not capable of wasting energy and explain some of its uses and limitations.
- List the three basic methods used to drive elevators.
- Identify common causes of energy waste at loading docks.

Lesson 5: Improving Vehicle Efficiency

Topics

Opportunities for Improvement; Vehicle Selection; Tires; Internal Combustion Engine or Electric?; Gasoline or Diesel?; Vehicle Operation; Maintenance and Repairs; The PM Program; Vehicle Maintenance—General; IC Engine Maintenance; Electric Vehicle Maintenance

Objectives

- Name the three basic areas offering energy conservation opportunities in vehicles.
- Explain why it is important to use the correct conservation opportunities in vehicles.
- Compare and contrast the applications of IC engine and electric vehicles.
- List as least ten tips for fuel-conscious vehicle operations.
- Describe what a PM program involves and tell why it is important.
- Tell why air cleaner care is important to an energy conservation program.
- Explain the importance of battery maintenance in an electric vehicle.

Electrical Energy Conservation

Course 380: Electrical Energy Conservation

Covers electrical energy consumers in typical commercial and industrial facilities. Investigates utility rate structures and relates cost to load management. Examines power factors, including how they are calculated and how they affect energy usage. Shows methods of conducting lighting surveys and how lighting fixture and lamp selection can impact electricity costs.

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

Lesson 1: Surveying Electrical Consumption

Topics

Identifying Electricity Consumers; Determining System Efficiency; Using Electrical Metering; Justification for Metering; Meters; Meter Selection; Determining Consumption; Evaluating Examples Using Meters

Objectives

- Conduct an electrical energy audit.
- Determine the efficiency of an electrical system.
- Give three reasons for metering electric energy use.
- Name the three basic types of meters used in energy conservation work and explain how each is used.
- Differentiate between indicating and recording meters.

Lesson 2: Using Load Management Techniques

Topics

Electrical Quantities; Load Factor; Electric Bill Audit; Graphic Record of Demands; Equipment Audit; Target Demand; Methods of Control; Manual Control; Automatic Control; Demand Controllers; Electric Rates; Calculating the Cost of Electricity

Objectives

- Name the two metered quantities that determine the major part of an electric bill.
- Define power factor and load factor and explain why each is important.
- Show how to use meters to identify usage patterns ad peak usage periods.
- Compare and contrast manual and automatic demand control and give an example of each.
- Name several types of demand controllers and tell how each operates.
- Describe the way in which electric bills are calculated.

Lesson 3: Improving Electrical Equipment Efficiency

Topics

Energy, Watts, and the Electric Circuit; Electrical Quantities; Capacitors; Induction Motors; Motor Operation; Motor Efficiency; Determining Motor Loading; Variable-Speed Drives; Transformers; Energy-Saving Devices

Objectives

- Name the two familiar forms energy may take.
- List three elements of impedance in an ac system.
- Explain how power factor is calculated in a single-phase and a three-phase circuit.
- Tell why capacitors are important from an energy conservation standpoint and name three sources of capacitance in an electrical system.
- Explain the information found on a motor nameplate and tell how it relates to energy on a electrical system.
- Calculate load losses and no-load losses of motors, speed controls, and transformers.
- Evaluate the value of energy-saving devices.

Lesson 4: Conducting a Lighting Survey

Topics

The Importance of Lighting; Lighting Levels; Measuring Lighting Levels; A Lighting Survey; Improve Switching; Remove Existing Lighting; Replace Existing Lighting; Reduce Lamp Size; Improve Lighting Controls; Modify Work Stations; Provide Task Lighting; Use Natural Light

Objectives

- Explain the importance of a good lighting system.
- Define uniform lighting and selective task lighting and tell how they affect energy consumption.
- Determine recommended and actual lighting levels
- Distinguish between lumens and footcandles as measures of light.
- Give examples of ways in which switching modifications can be used to reduce energy consumption.
- Describe several ways to use natural lighting more efficiently.

Lesson 5: Evaluating Lamps and Fixtures

Topics

Lighting Fixtures and Their Maintenance; Incandescent Lamps; Fluorescent Lamps; Scheduling Lamp Replacement; Comparing Fluorescent and Incandescent Lamps; High Intensity Discharge Lamps; Mercury Lamps; Metal-Halide Lamps; High-Pressure Sodium Lamps; Low-Pressure Sodium Lamps; HID Lamp Maintenance and Replacement

Objectives

- Tell why cleaning lamps and fixtures is important.
- Compare and contrast incandescent and fluorescent lamps.
- Differentiate between R lamps and ER lamps.
- Name six types of lighting in order of efficacy.
- List advantages and disadvantages of each of the following types of high intensity discharge lighting: mercury, metal halide, HPS, and LPS.

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.

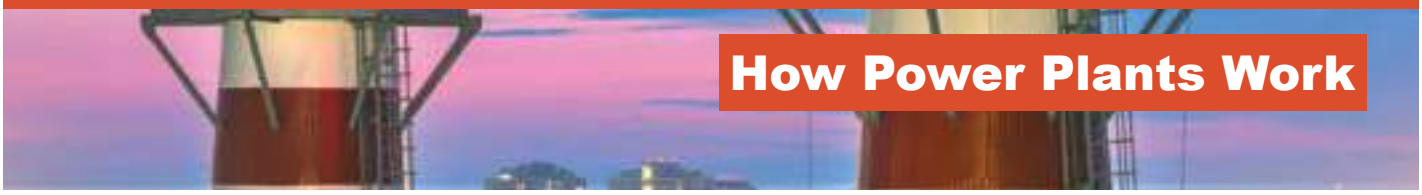
Lesson 5: Safety and Troubleshooting

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.

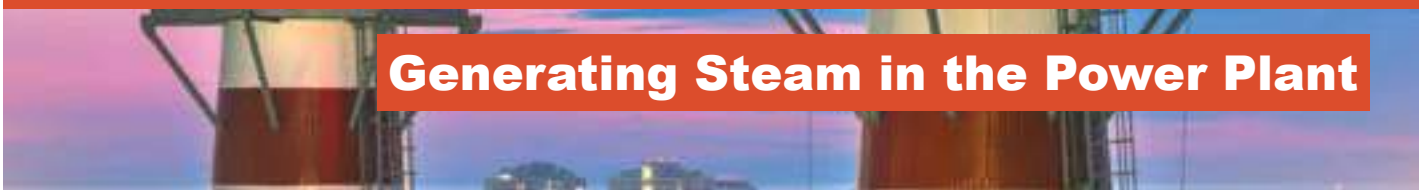
Lesson 5: Power Plant Operation and Control

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.



Generating Steam in the Power Plant

Course 112: Generating Steam in the Power Plant

Covers energy principles and boiler maintenance. Explains coal, oil, and natural gas combustion, and how to conserve energy through improved combustion control.

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

Lesson 1: Transforming Energy into Work

Topics

Energy and Matter; Fuels; Combustion; Temperature Measurement; Pressure Measurement; Quantity of Heat; Heat Transfer; Conduction; Radiation; Convection; Sensible and Latent Heat; Vaporization; Boiling Point; Enthalpy; Heat and Work; Basic Steam Generation

Objectives

- Define energy and describe the main forms of energy encountered in a power plant.
- Explain the process of combustion and list the three elements necessary for combustion to occur.
- Explain the principles of temperature and pressure measurement and describe the four scales on which temperature is measured.
- Describe the methods of heat transfer and the types of effects heat transfer can have on a material.
- Summarize the interrelationship of temperature, volume, and pressure in a gas.

Lesson 2: Boiler Operation

Topics

Types of Boilers; Boiler Characteristics; Water Treatment for Boiler Use; Boiler and Cooling Tower Blowdown; Wastewater Disposal; Efficiency in the Power Plant; Thermodynamic Efficiency; Conserving Energy in the Power Plant

Objectives

- Compare the two basic types of boilers.
- Describe the characteristics by which boilers are classified.
- Explain the different processes by which water is treated for use in a boiler.
- Define blowdown and explain its importance in boiler operation.
- List the problems associated with wastewater disposal and describe how these problems are overcome.
- Describe the factors that affect boiler efficiency, as well as auxiliary equipment efficiency.
- Calculate thermodynamic efficiency.
- List practices that aid in energy conservation in all areas of the power plant.

Lesson 3: Boiler Maintenance

Topics

Soot Removal; Scale Removal; Corrosion; Casing Corrosion; Refractory; Control Systems; Calibration and Cleaning; Compressed Air Systems; Maintaining Boiler Auxiliaries; Maintaining Stacks and Cyclones; Maintenance Schedules and Reports

Objectives

- Explain how the two types of sootblowers remove soot and slag from heat exchange surfaces.
- Describe how scale forms on boiler surfaces and list the three common removal methods.
- Explain why both hot-end and cold-end corrosion occur in a boiler, and tell what practices help prevent corrosion.
- Describe how refractory should be maintained and list the problems that can occur if it is not properly maintained.
- List the primary functions of boiler control systems and describe the three common types.
- Explain how to calibrate and clean boiler control systems and maintain compressed air systems.
- Summarize maintenance procedures for boiler auxiliaries such as pumps, valves, motors and electric circuits.

Lesson 4: Combustion and How It Works

Topics

Coal Ranks; Coal Analyses; Coal Sizes; Coal Storage; Oil Properties; Natural Gas; Chemistry of Combustion; Oil Burners; Gas Burners; Flame Color; Flame Adjustment for Oil and Gas; Coal Firing Systems; Pulverized Coal Burners; Overfeed Stokers; Underfeed Stokers; Ash Analysis for Carbon; Combustion Efficiency; Handling Unburned Solids

Objectives

- Identify the different ranks of coal and describe how the makeup of coal affects its heating value.
- List the properties that are tested in a coal analysis.
- Summarize the properties of oil and natural gas fuels.
- Explain the combustion process in detail.
- Describe how to interpret and adjust a flame's characteristics in coal, oil, and gas burners.
- Describe the three types of coal firing systems.
- List the ways in which combustion efficiency is measured.

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Generating Steam in the Power Plant

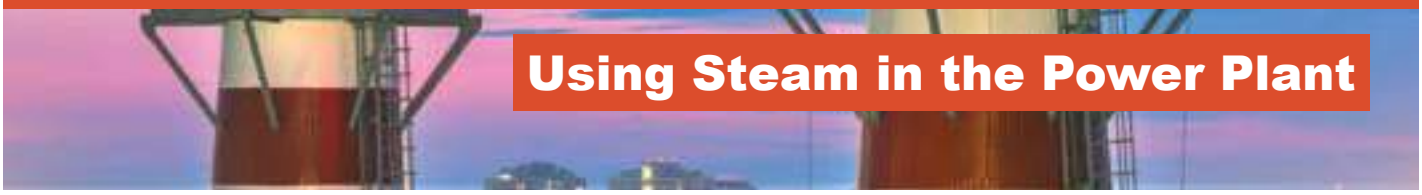
Lesson 5: Steam Generation

Topics

The Steam Generation Process; Temperature and Pressure Relationship; Superheating Steam and Steam Quality; Volume and Pressure Relationship; Steam Tables for Saturated Steam; How to Use Steam Tables; Circulation of Boiler Water; Steam Circulation and Tube Temperature; Steam Drum Design; Operating a High-Pressure Boiler at Low Pressure; The Complete Steam Generation System; Conserving Energy; Blowdown; Makeup Water

Objectives

- Trace the flow of water and steam through the boiler system.
- Explain the relationship between temperature and pressure and explain why superheated steam has a higher quality than saturated steam.
- Read a steam table properly and apply its information to a boiler system.
- Compare natural circulation boilers with forced circulation boilers, and explain how pressure and temperature affect the type of boiler used.
- Describe the process of operating a high-pressure boiler at low pressure.
- Describe how proper maintenance of steam traps, valves, packing, flanges, and insulation improve the energy conservation rate in a boiler system.



Using Steam in the Power Plant

Course 113: Using Steam in the Power Plant

Covers how to conserve energy in turbines, auxiliaries, electric power generation, and air conditioning systems.

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

Lesson 1: Turbines

Topics

What is a Turbine?; Operating Principles; Turbine Classification; Gas Turbines; Condensers; Heat Rejection and Thermal Pollution; Boiler-Turbine-Generator Efficiency; Operating Data on Turbine-Generator Performance; Maintaining a Turbine-Generator System; Condenser Cooling Water Requirements; Cooling Water Systems

Objectives

- Name the five main parts of a steam turbine system and explain the function of each.
- Contrast the operating principle of an impulse turbine and a reaction turbine.
- Define the terms tandem compound and cross compound.
- Explain how a condenser improves turbine efficiency.
- Explain how an overspeed trip is activated.
- List three causes of turbine rotor vibration.
- Name the main cause of bearing failure in a turbine.

Lesson 2: Boiler Instrumentation, Controls, and Safety

Topics

Boiler Instrumentation; Pressure Measurement; Bourdon Tube Gauges; Manometers; Diaphragm and Bellows Gauges; Flowmeters; Temperature Gauges; Gauge Glasses; Combustion Control; Feedwater Control; Safety Devices

Objectives

- Define the term variable.
- Describe the three main classes of boiler instruments.
- List the four variables on which boiler instrumentation usually provides data.
- Name the four common types of pressure gauges, and describe the characteristics and uses of each.
- Name and describe the three types of flowmeters commonly used in power plants.
- Name and describe the four types of temperature gauges commonly used in power plants.
- Describe the uses for gauge glass assemblies in power plant instrumentation.
- Explain the purpose of combustion control systems and describe the three basic kinds.
- Describe the three kinds of feedwater regulators.
- Explain the importance of safety valves and flame safety devices in power plants.

Lesson 3: Electrical Power Fundamentals

Topics

Fundamentals of Electricity; Ohm's Law for DC Circuits; Power in DC Circuits; Theories of Magnetism; Circuit Components; Circuit Types; Generators; Phase Difference; Power Factor; Three-Phase Systems; Transformers; Metering Principles; Instrument Transformers; Electric Distribution Systems and Equipment; Protective Equipment; Distribution Wiring; Substations

Objectives

- Explain the basic principles of electricity and electric power, including the significance of Ohm's Law.
- Identify the parts of an electrical circuit and describe the function of each part.
- Contrast series and parallel circuits.
- Explain the difference between the two main groups of generators and further describe each group in terms of its sources of mechanical power.
- Define phase difference and power factor, and describe a three-phase system.
- Explain the function of a transformer.
- Describe the variety of metering instruments used to measure the value of electric energy.
- Explain the purpose of an electric distribution system, and list the three main kinds.
- Name four kinds of protective equipment used in power systems.

Lesson 4: Electrical Systems Analysis

Topics

Line Diagrams; Electrical Power Billing; Electrical Demand Considerations; Determining Load Factor; Demand Analysis; Manual and Automatic Control; Demand Costs; Power Systems Analysis; Low Power Factor Costs; Causes of Low Power Factor; Power Factor Correction; Capacitors; Synchronous Motors; Transformer Losses; System Voltage Variation and Losses; Maintaining Protective Devices; Maintaining Cable Systems; Maintaining Generators and Motors; Conservation

Objectives

- Explain the purpose of a line diagram.
- List the four kinds of charges normally found on a power bill.
- Define peak demand.
- Calculate a plant's load factor.
- Describe the steps involved in performing demand analysis.
- Calculate demand cost and explain the effect of short demand peaks on billing.
- Define power factor and explain how it is calculated, what causes it to be low, and how it can be improved.
- List the types of power losses that occur in transformers and describe the cause of each.
- Explain how to maintain protective devices, cable systems, and generators and motors.
- Explain the importance of energy conservation in power plants.

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Using Steam in the Power Plant

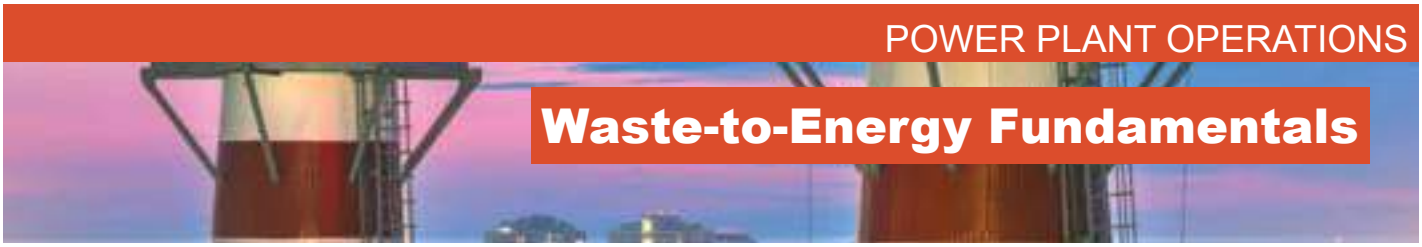
Lesson 5: Air-Conditioning Systems

Topics

Temperature and Humidity; Basic Air-Conditioning Cycle; Air-Conditioning Compressors; Condensers; Evaporators; Metering Devices; Accessories; Controls; Absorption Systems; Air-Handling Systems; Maintenance Practices to Improve Efficiency; Air-Handling System Maintenance

Objectives

- Define relative humidity and explain how it is measured.
- Define the terms refrigeration ton and refrigeration effect.
- Name and describe the three common kinds of compressors used in air-conditioning systems.
- Name and describe the three kinds of condensers used in air-conditioning systems.
- List the metering devices used in an air-conditioning system and explain their uses.
- List the accessories and controls that are found in an air-conditioning system and state their purposes.
- Describe the air-handling system and its components.
- Explain how to measure velocity pressure and static pressure.
- Explain several maintenance practices that will improve the efficiency of an air-conditioning system.



Waste-to-Energy Fundamentals

Course 114: Waste-to-Energy Fundamentals

Covers fundamentals of waste combustion - characteristics and handling of MSW fuel, furnace designs, waste combustion, and plant operations.

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

Lesson 1: Introduction to Waste Combustion

Topics

History of Waste Management; Benefits of Converting Waste to Energy; Environmental Regulations; The Clean Air Act; Current Guidelines; Permit Program; Reporting Procedures

Objectives

- Summarize the history of waste handling.
- List some problems associated with landfills and the benefits of waste-to-energy conversion.
- Name the federal regulations that apply to MWCs.
- Explain how NSPS regulations affect the operation of MWCs.
- Explain the permitting program.

Lesson 2: Characteristics of MSW Fuel

Topics

MSW Definitions; MSW Classification and Composition; MSW Handling Safety; MSW and Refuse-Derived Fuel; MSW Compared to Fossil Fuels

Objectives

- State the definition of MSW and list some kinds of waste excluded from MSW.
- Explain the various methods of classifying MSW.
- Discuss safety concerns related to the handling of MSW.
- Explain the differences between mass-burn MSW and RDF.
- Compare and contrast MSW and fossil fuels.

Lesson 3: MSW Handling

Topics

Solid Materials Flow Path; Weight Scale Operation; Tipping Floor and Refuse Pit; Receiving and Feeding Equipment; Front-End Conveyor Systems; Feed Systems; Ash Removal

Objectives

- Describe the MSW flow in a mass-burn and an RDF facility.
- Explain the responsibilities of the weight scale operator.
- Describe the tipping floor and refuse pit.
- Explain how odors are managed is an MSW facility.
- List typical receiving and feeding equipment and explain its functions.
- Describe how conveyors are used in a typical RDF facility.

Lesson 4: Furnace Designs

Topics

History of MWCs; MWC Designs; Mass-Burn Designs; Rotary Combustors; RDF Designs

Objectives

- Explain the impact of corrosion on MWC design.
- Describe mass-burn and RDF feed systems.
- Explain the operation of the following types of stokers: reciprocating grate, reversed reciprocating grate, oscillating grate, roller grate, and traveling grate.
- Define and contrast overfire air and underfire air and explain why the control of combustion air is important.
- Explain the advantages and disadvantages of a rotary combustor.

Lesson 5: Municipal Waste Combustion

Topics

The Combustion Process; Municipal Solid Waste as Fuel; Theoretical Air and Excess Air; Heating Value; Charging Rate; MSW Combustor Capacity; Combustion Temperatures; Reaction Rates; Air Pollution Control Equipment; Slag and Soot

Objectives

- Explain the combustion process as it occurs in a municipal waste combustor.
- Name the two main factors that determine feed rate.
- Define the terms theoretical air and excess air and tell why they are important.
- Explain the use of common air pollution control equipment and processes.
- Tell how soot and slag are formed and how they are removed.

Lesson 6: Ash Handling and Material Recovery

Topics

Characteristics of MSW Ash; Ash Safety and Handling Requirements; Ash Treatment and Testing Programs; Ash Transport and Loading Systems; Material Recovery

Objectives

- Describe the characteristics of MSW ash.
- Explain the safety considerations when handling MSW ash.
- List the major ash handling equipment.
- Describe the ash treatment and testing program.
- List the materials recovered from ash.
- List some potential uses for ash.

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Waste-to-Energy Fundamentals

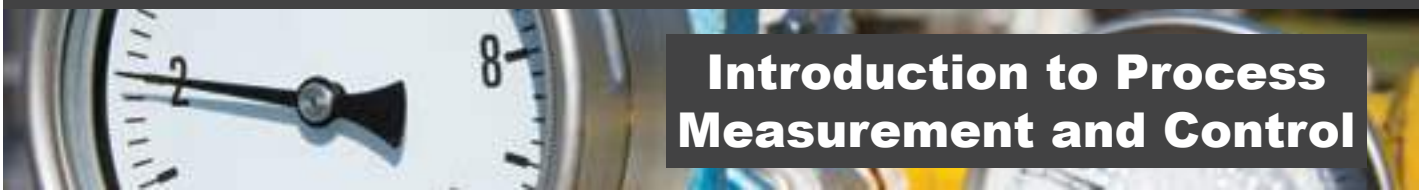
Lesson 7: Integrated Plant Operations

Topics

Principles of Plant Operation; Operator Training; Upset Conditions; Operating Procedures; Troubleshooting Concepts; Basic Plant Economics

Objectives

- State the main responsibilities of an MWC operator.
- Define the terms turnover, parameter, and walkdown as they relate to MSW operations.
- Explain the importance of operator training.
- Describe the three upset conditions in an MWC that can be dangerous to personnel and property.
- List the causes and symptoms of common MWC process problems.
- List the three sources of profit in a typical MWC.



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

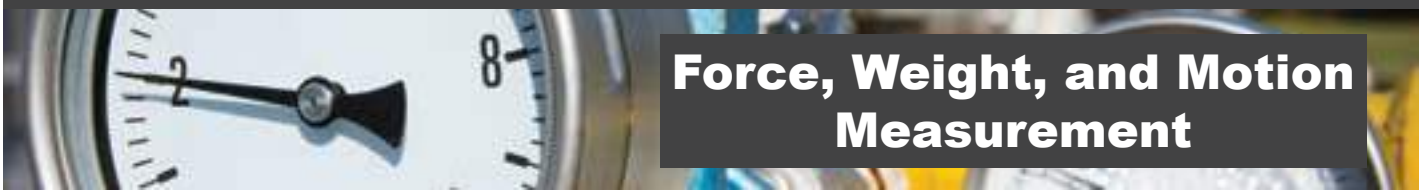
Lesson 5: Installation and Service

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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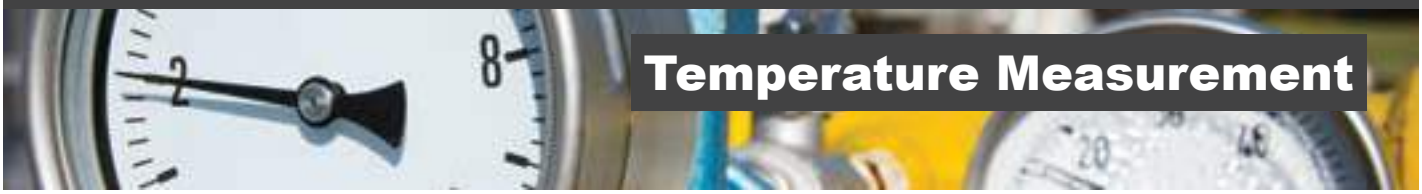


Temperature Measurement

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.

Analytical Instrumentation

Course 278: Analytical Instrumentation

Covers principles, installation, calibration, and maintenance of conductivity probes, and methods of stack gas monitoring. Includes how to install, calibrate, and maintain pH and ORP measurement instruments and operation, installation, calibration, and maintenance of several optical analyzers. Discusses principles and safe practices governing sensors used in measuring oxygen, carbon monoxide, carbon dioxide, and other products of combustion. Concludes with operation, calibration, and system components in liquid and gas chromatography.

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

Lesson 1: Measuring Conductivity

Topics

Ion Concentration; Conductivity; Variables Affecting Conductivity; Conductivity Probes; Probe Calibration; Liquid Standard Calibration; Wire Loop Calibration; Checking a Grab Sample; Probe Installation; Maintenance; Stack Gas Analyzers

Objectives

- Define conductivity and discuss the basic principles governing conductivity.
- Compare the operation of electrode probes and inductive probes.
- Describe two procedures for calibrating conductivity probes.
- Discuss proper installation and maintenance practices for conductivity probes.
- Discuss the operation of stack gas analyzers.

Lesson 2: Measuring pH and ORP

Topics

Introduction to pH and ORP; pH Measurement; Temperature and pH; ORP Measurement; pH and ORP Reference Electrodes; pH and ORP Measurement Electrodes; Calibration Using Standards; Calibration Using a Grab Sample; Calibration Problems; Probe Installation; Probe Mounts; Probe Maintenance

Objectives

- Describe pH and ORP measurement processes.
- Describe the instruments used for the measurement of pH and ORP.
- Discuss calibration procedures for pH and ORP measurement instruments.
- Discuss general installation and maintenance procedures for pH and ORP measurement instruments.

Lesson 3: Optical Measurements

Topics

Optical Measurements; Transmission-Type Optical Analyzers; Examples of Transmission-Type Optical Analyzers; Turbidimeter and Nephelometer; Refractometer; Capacity Analyzer; Analyzer Calibration; Calibration Problems; Analyzer Installation; Pressure Reduction; Temperature; Analyzer Maintenance; Maintenance Problems

Objectives

- Describe the components that make up an optical analyzer.
- Discuss the basic operating procedures of silica ion and COD optical analyzers, turbidimeters and nephelometers, refractometers, and capacity analyzers.
- Compare procedures for calibrating an optical analyzer with standards, with grab samples, and electronically.
- Discuss installation considerations and basic maintenance procedures for an optical analyzer.

Lesson 4: Measuring Products of Combustion

Topics

Gas Sensors; Oxygen Sensors; Carbon Dioxide and Carbon Monoxide Sensors; Combustible Gas Sensors; Calibrating Analyzers; Calibration Problems; Installation; Maintenance

Objectives

- Identify the main components in the combustion process.
- Describe the various kinds of instruments used for measuring the products of combustion.
- Discuss the principles of operation of instruments that measure the products of combustion.
- Describe the basic maintenance procedures for instruments that measure the products of combustion.
- Discuss the various sampling techniques for measuring the products of combustion.

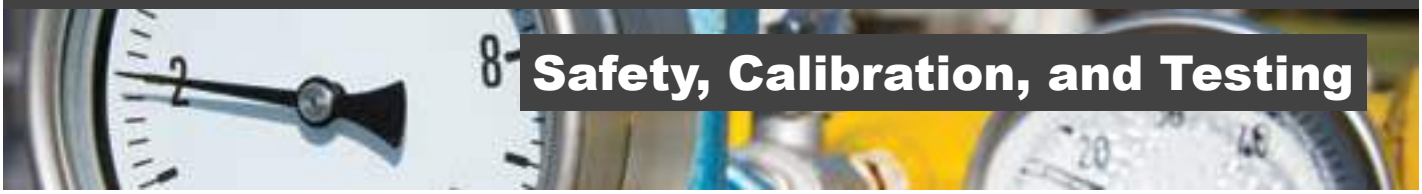
Lesson 5: Chromatography

Topics

Chromatograph Operation; Gas Chromatography; System Valves; Detectors; Liquid Chromatography; Chromatograms; Calibration; Chromatography Variables; Installation and Maintenance

Objectives

- Discuss the principles of chromatograph operation.
- Describe four kinds of detectors used with chromatographs.
- Describe four kinds of liquid chromatographs.
- Explain how to read a chromatogram.
- Discuss chromatograph calibration techniques and identify variables that can affect chromatograph accuracy.
- Discuss chromatograph maintenance considerations.



Safety, Calibration, and Testing

Course 280: Safety, Calibration, and Testing

Covers the responsibilities of employer, employee, and regulatory agencies in maintaining safety. Discusses ways of identifying and handling chemical, electrical, biological, radiation, and mechanical hazards. Discusses importance of maintenance (including calibration) and proper record keeping. Describes use of common electrical and electronic test instruments. Offers guidelines for handling heavy equipment, decontaminating and servicing pneumatic and hydraulic equipment, and troubleshooting. Discusses specification details, conversion between English and SI units, calibration methods, and the maintenance of records.

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

Lesson 1: Safety Standards and Practices

Topics

Identifying Hazards; Safety Regulations; Employer Responsibility; Your Responsibilities; Government Safety Regulations; Compressed Gases; Chemical Hazards; Electrical Hazards; Biological Hazards; Radiation Hazards; Mechanical Hazards; Noise Pollution; General Precautions

Objectives

- Discuss kinds of hazards and compare employer and employee responsibilities relating to safe job practices.
- Describe safe procedures for working with compressed gases, acids, flammable solvents, and other hazardous chemicals.
- Describe ways to minimize the possibilities of hazardous or lethal electric shock, including safe lockout procedures.
- Explain the use of dosimeters.
- Identify potential safety hazards in the instrument shop and along the process control network and describe the use of appropriate safety equipment for each hazard.

Lesson 2: Servicing Fundamentals

Topics

Why Is Instrument Servicing Necessary?; Repair Modes; Repair Records; Failure Mode Analysis; Maintenance Modes; Maintenance Records; Calibration Modes; Calibration Records; Calibration Seals; Care of Tools and Equipment; Shop Layout and Operations

Objectives

- Compare methods of on-site and shop repair of malfunctioning instruments.
- Describe the differences between repairing, maintaining, and calibrating instruments.
- Describe the contents of an equipment history file and a process loop file.
- Discuss the benefits of failure mode analysis.
- Describe proper calibration procedures, including use of calibration seals, and explain what NIST-traceable means.
- Describe the typical main sections of an industrial instrument shop.

Lesson 3: Electrical and Electronic Stations

Topics

Test Station Requirements; Electrical Station; Electronic Station; Electrical Test Equipment; Electronic Test Equipment; Pneumatic and Hydraulic Test Equipment; Test Stands; On-Site Operations; Calibration; Maintenance Records and Files

Objectives

- Describe the differences between electrical and electronic test areas.
- Describe how the ammeter, megohmmeter, wattmeter, and dynamometer are used in electrical work.
- Describe how the multimeter, signal/waveform generator, oscilloscope, voltage and current source, and frequency counter are used in electronics.
- Discuss the benefits of accurate calibration and thorough equipment maintenance records.
- Explain how test stands are used and name three kinds of operations that are typically conducted on site.

Lesson 4: Pneumatic and Hydraulic Stations

Topics

Purpose of Pneumatic/Hydraulic Stations; Power Requirements; Handling Heavy Equipment; Cleaning and Decontamination; Safety in Cleaning; Testing and Evaluation; Disassembling the Equipment; Reassembling the Equipment; Calibration; Test Stands; On-Site Servicing

Objectives

- Describe the layout and power requirements of a typical pneumatic/hydraulic station.
- Describe safe and efficient methods of cleaning pneumatic and hydraulic instruments and controls.
- Discuss procedures for testing and evaluating a faulty component, using the calibration of a pressure-to-current (P/I) transmitter as an example.
- Describe proper procedures for disassembling and reassembling pneumatic and hydraulic components.
- Name the steps in preparing to service instruments on site.

Safety, Calibration, and Testing

Lesson 5: Instrument Troubleshooting

Topics

Troubleshooting Requirements; Knowledge of the Equipment; Manufacturer's Literature; Maintenance and Repair Records; Tools and Test Instruments; Calibration Standards; Troubleshooting Techniques; Gathering Information; Checking the Records; Returning the Loop to Operation; Inspecting the Instrument; In-Shop Troubleshooting; Recording the Repair

Objectives

- Explain how an understanding of the process and its instrumentation reduces troubleshooting time.
- List at least four kinds of information typically included in a manufacturer's manual or instruction book.
- Describe the contents of an instrument history file and explain its usefulness in troubleshooting.
- Discuss the kinds of tools, including calibration standards, you are apt to use in troubleshooting.
- Describe the steps in a typical troubleshooting procedure and explain how to use a branching troubleshooting chart.
- Describe cascading failure.

Lesson 6: Systems Specifications and Instrument Calibration

Topics

Interpreting Specifications; Error; Accuracy; Precision; Resolution; Transfer Function and Sensitivity; Hysteresis; Response Time; Time Constant; Units of Measurement; SI Units; English Units; Calibration; Standards; Calibration Laboratory; Field Calibration

Objectives

- Discuss the specifications of a typical measurement system.
- Explain how to read a graph showing a linear or nonlinear transfer function, hysteresis, or the time constant.
- Discuss SI and English systems of units and explain how to convert from one to the other.
- Describe the elements of instrument calibration.
- Discuss the standards commonly used in instrument calibration.

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.

Introduction to Water Technology

Course 381: Introduction to Water Technology

Covers the nature, use, and properties of water. It traces the history of water treatment methods from ancient times to today's sophisticated systems. The effects of chemical and biological factors on the purity of water are explained.

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

Lesson 1: Water: The Basic Resource

Topics

The Water Cycle; Precipitation; Surface Runoff; Groundwater; Lots of Water, But...; How We Use Water; Municipal Use; Industrial Use; Agricultural Use; Waste Disposal; Waste Not - Want Not; Beginning of Waterworks; Roman Waterworks; Centuries of Neglect; Beginning of Water Treatment; Upgrading Water Today

Objectives

- Name the continuing processes that make up the water or hydrologic cycle.
- Describe the atmospheric process that produces precipitation.
- Identify the users of municipal water supplies.
- Point out some of the important advances made in water treatment since 1900.
- List the benefits of the Federal Water Pollution Control Act Amendment of 1972.

Lesson 2: Water Collection, Treatment, and Distribution

Topics

Collecting Surface Water; Collecting Ground Water; Transmission of Water; Why Treat the Supply Water?; Types of Treatment; Treatment in the Treatment Plant; Distributing Treated Water; Collecting Wastewater; Treating Wastewater; Primary Treatment; Secondary Treatment; Tertiary Treatment

Objectives

- Explain the differences between a confined aquifer and an unconfined one.
- Tell why it is necessary to treat water for drinking and for manufacturing purposes.
- Describe the treatment processes of sedimentation and coagulation.
- Describe how a system for the distribution of treated water operates.
- Tell what takes place during the primary treatment of wastewater.

Lesson 3: Physical Properties of Water

Topics

Basic Properties of Water; The Color of Water; Measuring Water Color; Taste and Odor of Water; The Temperature of Water; Solids in Water; Total Solids in Water; Volatile and Fixed Solids; Turbidity and Suspended Matter; Electrical Conductivity; Measuring Conductivity

Objectives

- Distinguish between the apparent color and the true color of water.
- Name the four basic tastes of water that a person can sense.
- Tell how a rise in temperature affects the various properties of water.
- Name the sources of organic and inorganic solids that pollute wastewater.
- Explain the differences between suspended solids and dissolved solids.

Lesson 4: Chemical Properties of Water

Topics

Atoms and Molecules; Acids, Bases, and Salts; The Ionization of Water; Alkalinity; Acidity; Hardness of Water; Other Unwanted Chemicals; Dissolved Oxygen

Objectives

- Identify the particles in an atom, and tell how they fit together to form the atom.
- Describe the relationship between a pH number and the concentration of H+ ions.
- Name the two color tests for alkalinity of water and tell what colors they produce.
- Describe the ion exchange and lime-soda processes for removing hardness from water.
- Tell why a certain amount of dissolved oxygen (DO) is necessary in surface water.

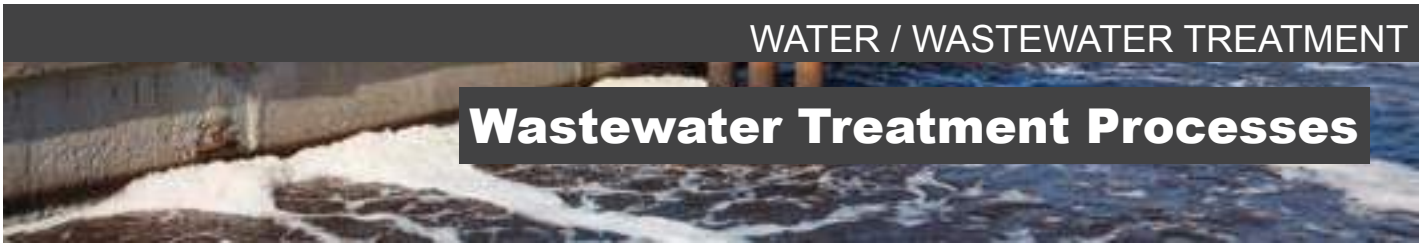
Lesson 5: Biological Properties of Water

Topics

Pathogenicity; Disinfection; Stabilization of Organic Matter; Biochemical Oxygen Demand; Factors Affecting Growth; The Food Chain; Types of Living Things; Bacteria; Environmental Classifications of Bacteria; Bacteria in Treatment Plants; Viruses; Algae; Protozoa; Higher Organisms

Objectives

- List the methods commonly used to disinfect water.
- Tell how temperature changes affect the rate at which living organisms grow in water.
- Tell how—and how rapidly—common bacteria reproduce.
- List the most effective methods used to inactivate viruses.
- Explain how the presence of algae speeds the process of eutrophication.



Wastewater Treatment Processes

Course 382: Wastewater Treatment Processes

Covers the various stages of wastewater treatment. Goes into detail on the removal of solids, then explains the use of chemical and biological processes for water purification. Covers the treatment and disposal of the extracted solids.

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

Lesson 1: Overview of Wastewater Treatment

Topics

Purpose of Treatment; Sources of Wastewater; Wastewater Collection Systems; Typical Treatment Facilities; Influent; Preliminary Treatment; Primary Treatment; Secondary Treatment; Tertiary Treatment; Disinfection and Effluent Discharge; Solids Handling

Objectives

- List the purposes of wastewater treatment.
- Describe the way organic wastes pollute water.
- Identify elements of wastewater collection systems.
- Stages of wastewater treatment at typical treatment facility.
- Explain what happens to wastewater during preliminary, primary, secondary, and tertiary treatment.
- Describe methods of solids handling.

Lesson 2: Physical Separation of Solids

Topics

Screening; Grinding; Grit Removal; Primary Sedimentation; What Happens During Sedimentation?; Factors Affecting Settling Rates; Types of Clarifiers; Air Flotation; Filtration; Eflluent Disposal

Objectives

- Identify and describe the different types of bar and woven screens used for screening.
- Identify and describe common types of grit-removal equipment.
- List factors affecting settling rates.
- Figure the length of detention time needed to settle out settleable particles.
- Describe the three principal methods of land disposal.

Lesson 3: Chemical Treatment Processes

Topics

Solids in Wastewater; Chemical Coagulants; Phosphate Removal; Chemical Clarification Equipment; Disinfection; Factors Affecting Disinfection; Disinfection with Chlorine; Equipment Used in Chlorine Feeding

Objectives

- Describe what colloidal particles are and outline the problems associated with removing them from wastewater.
- List chemicals used as coagulants.
- Explain how the flocculation process works.
- Explain the function of a precipitant.
- List chemical agents commonly used as disinfectants.
- Identify factors affecting disinfection.
- Describe methods for applying chlorine to wastewater.

Lesson 4: Biological Processes

Topics

Lagoons; Activated Sludge; Aeration with Pure Oxygen; Trickling Filters; Distribution Systems; Trickling Filter Operations; Synthetic Media; Activated Biofilter Process (ABF); Rotating Biological Contactors (RBC); Secondary Clarifiers

Objectives

- Differentiate between the way unaerated and aerated lagoons function.
- Distinguish between suspended growth and fixed-growth systems.
- List and describe different methods of utilizing activated sludge to stabilize wastewater.
- Tell how trickling filters, ABFs, and RBCs operate.
- Explain how secondary clarifiers are used in conjunction with fixed- and suspended-growth systems.

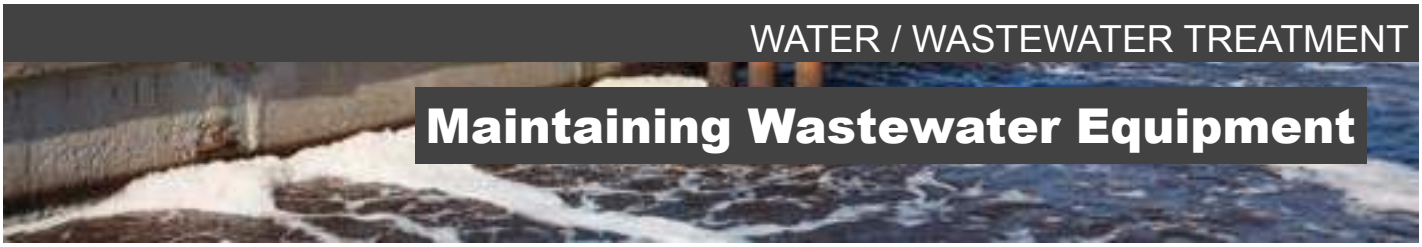
Lesson 5: Solids Treatment and Disposal

Topics

Three Processes; Sludge Conditioning; Thickening; Dewatering; Drying Beds; Lagoons; Vacuum Filtration; Filter Presses;Further Reduction of Water Content; Composting; Ultimate Disposal

Objectives

- Distinguish between conditioning, thickening, and dewatering.
- List the factors that affect which conditioning, thickening, and dewatering methods are used.
- Describe four methods of sludge conditioning.
- Describe three methods of thickening.
- List factors that affect drying-bed operation.
- Describe methods for disposing of digested or dewatered sludge.



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.

Industrial Rigging Principles and Practices

Course 318: Industrial Rigging Principles and Practices

Covers techniques and safeguards in the use of rope, chain, hoists, and scaffolding when moving heavy plant equipment and maintaining plant utilities.

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

Lesson 1: Introduction to Industrial Rigging

Topics

Tools of Industrial Rigging; the Rigging System; Determining the Weight of a Load; Calculating an Allowable Load; Determining Center of Gravity; Vertical and Horizontal Force; Types of Slings; Hooks; Hoist Hooks; Special-Purpose Rigging Hooks; Hook Operating Practices

Objectives

- Identify the tools used in rigging and explain the purpose of each.
- Give examples of three methods of calculating the weight of a load.
- Explain center of gravity and its importance in rigging a load.
- Describe four common sling arrangements and the relation between sling angle and horizontal force.
- Name five types of hooks frequently used in rigging and explain the purpose of each.
- Discuss proper hook use and cite four reasons for removing a hook from service.

Lesson 2: Wire Rope and Wire-Rope Slings

Topics

Wire Rope; Wire-Rope Construction; Wire-Rope Classification; Wire-Rope Strength; Factors Affecting Wire-Rope Strength; Seizing, Cutting, and Splicing; Wire-Rope Slings; Inspecting Wire-Rope Slings

Objectives

- Identify the component parts of wire rope and describe its construction and classification.
- Identify and discuss the factors that affect wire rope strength.
- Describe the basic single-leg and multiple-leg slings and the calculation of their allowable loads.
- Enumerate the signs of damage that would probably cause a wire rope to be removed from service.

Lesson 3: Chain and Metal-Mesh Slings

Topics

Welded-Link Chain; Chain Grades; Chain Strength; Factors Affecting Chain Strength; Chain Slings; Inspecting Chain Slings; Metal-Mesh; Metal-Mesh Slings; Metal-Mesh Sling Materials; Factors Affecting Metal-Mesh Sling Strength; Inspecting Metal-Mesh Slings

Objectives

- Identify the different grades of chain and name some of their applications.
- Define the terms working load limit, proof test, and minimum breaking force.
- List and discuss four factors that affect the strength of chain slings.
- Describe three types of damage you might see in a daily inspection of chain slings that would lead you to set the sling aside for more thorough examination.
- Describe the two standard types of end fittings for metal mesh slings and the hitches for which each can be used.
- Name several advantages of, and applications for, metal mesh slings.
- List the visible signs of damage that would cause you to recommend a sling's removal from service.

Lesson 4: Fiber Rope and Webbing Slings

Topics

Fiber Rope; Natural-Fiber Rope; Synthetic-Fiber Rope; Fiber-Rope Strength; Factors Affecting Fiber-Robe Strength; Whipping Rope Ends; Splicing Fiber Rope; Inspecting Fiber-Rope Slings; Encased Polyester-Fiber Slings; Synthetic Webbing; Synthetic-Web Slings; Factors Affecting Web-Sling Strength; Inspecting Synthetic-Web Slings

Objectives

- Identify the grades of manila rope that can be used for overhead lifting.
- Name the three commonly used synthetic-fiber ropes and list three of their advantages over manila.
- Discuss the factors that affect the strength of fiber rope.
- Name the signs of wear or damage that would warrant setting a fiber-rope sling aside for more detailed inspection.
- Describe an encased polyester fiber sling.
- Explain the construction of synthetic-web slings and name four of the basic types.
- List examples of visible damage that should cause a synthetic-web sling to be removed from service.

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Industrial Rigging Principles and Practices

Lesson 5: Industrial Hoists and Cranes

Topics

Industrial Hoists and Cranes; Overhead Manual Chain Hoists; Overhead Power Hoists; Overhead Wire-Rope Hoists; Types of Wire-Rope Hoists; Operating a Wire-Rope Hoist; Side Pull;Overload Limit Device; Underhung and Top-Running Cranes; Jib Cranes; Hoist and Crane Inspection; Inspecting Hooks, Wire Rope, and Chain

Objectives

- Describe the characteristics of the various kinds of overhead hoists.
- Explain the differences between single and double reeving.
- Explain the proper function and operation of an upper limit switch and an overload limit device.
- Describe and contrast the construction of top-running and underhung cranes.
- Identify the three basic types of jib cranes.
- Describe what the rigger's daily visual inspection should include.
- List examples, from the additional criteria given in this lesson, of conditions that should warrant removal of wire rope or hoist load chain from service.

Lesson 6: Operating Practices

Topics

General Practices; Sling Operating Practices; Hoist and Crane Operation; Special Heavy Lifts; Pulling a Load; Setting a Load; Turning a Load; Eyebolts; The Thought Process of Rigging

Objectives

- Enumerate the general operating practices that apply to all tools of rigging.
- Explain the 11 operating practices that apply to slings.
- Discuss nine operating practices that should be observed when using a hoist or crane.
- Detail the special circumstances under which a hoist or crane may be used to pull a load or lift a load heavier than the equipment's rated capacity.
- Describe three methods of turning a load.
- Discuss the eight questions that a rigger must answer in the thought process that should precede any lift.

Lesson 7: Scaffolds and Ladders

Topics

Scaffolds; Scaffold Planking; Types of Scaffolding; Workmen's Lift Platforms; Suspension Scaffolds; Guy Lines; Scaffolding Accessories; Ladders; How to Raise a Ladder; Inspecting Ladders; Life Belts; Scaffold Safety; Ladder Safety

Objectives

- Explain the construction of pole and suspension scaffolds and lift platforms, and the safety measures that apply to them.
- Name several scaffolding accessories and explain their use.
- Discuss recommended usage and inspection of the three common types of ladders.

Equipment Installation

Course 319: Equipment Installation

Covers installation procedures for large plant equipment. Considers factors affecting proper installation in detail, from preparatory relocation of underground piping and wiring, through equipment anchoring, aligning, and test running.

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

Lesson 1: Preparing the Site

Topics

The Engineer Plans the Installation; The Maintenance Supervisor's Responsibilities; Relocating Underground Piping; Relocating Underground Wiring and Cables; Protecting Nearby Buildings and Equipment; Barricading the Work Area; Removing Excavated Material; Foundation and Footings; Reinforced Concrete; Materials for Reinforcing Concrete; Using Wooden Forms; The Right Concrete Mixture; Materials for Fill around Foundation; Positioning Anchor Bolts with a Template; Installing Alignment Plates; Surface Finish of Concrete; Setting or Curing Time for Concrete; Finishing Flooring around Foundation; Outdoor Foundations; Safety Precautions for Excavation Work

Objectives

- Tell who plans the installation of new equipment and list the steps involved.
- Define the terms foundation and footing.
- Tell which type of ground will support the most weight.
- Explain how steel rods are held in position when pouring a concrete footing.
- Name the best materials for filling around a foundation.
- Explain how to protect concrete that might come into contact with oil or chemicals.
- Tell how long new concrete must sit before equipment is installed on it.

Lesson 2: Vibration Control and Anchoring

Topics

Reasons for Controlling Vibration; How to Control Vibration; Selecting Anchors and Isolators; Isolating the Foundation; Isolator Mounts; Using Anchor Bolts; Types of Anchor Bolts; Drilling Anchor Bolt Holes; Using Power Hammers; Grouting

Objectives

- Define vibration and tell how it enters and leaves equipment.
- Tell what type of isolation is best to use on sensitive testing instruments.
- Explain how to isolate anchor bolts when mounting equipment on pads.
- Tell what type of wrench to use for tightening anchor bolts.
- Name the best tool for drilling anchor bolt holes in concrete.
- Tell why the bases of production and processing equipment should be grouted.
- Explain why you must not use a concrete mix to grout anchor bolts.

Lesson 3: Moving and Setting

Topics

Uncrating New Equipment; Relocating Existing Equipment; Know the Weight of the Load; Machinery for Lifting Equipment; Raising Equipment with Jacks; Lifting Plant Equipment with Slings; Hand Tools for Moving Equipment; Crowbars; Preparing to Move the Equipment; Making the Move; Setting the Equipment in Position; Personal Safety during Installation

Objectives

- Explain the procedures involved in relocating existing equipment.
- Tell two things you must know before lifting equipment with a hoist.
- List three things to consider when selecting a jack.
- Explain the operation and uses of a roller skid.
- Tell where to find a floor's allowable load.

Lesson 4: Leveling and Aligning

Topics

Leveling Devices; Checking the Accuracy of Levels; Using Spirit and Electronic Levels; Using the Optical Level; Leveling Feet and Bolts; Wedges and Shims; Tools for Checking Alignment; Aligning Equipment on the Foundation; Using Alignment Screws; Aligning Machine Tool Equipment; Other Plant Equipment

Objectives

- Explain the correct way to handle a master precision level.
- Explain how to check the accuracy of a level.
- Name the greatest enemy of precision tools.
- Explain how to level V-shaped ways.
- Tell which leveling device is used most often on small equipment.
- Name three tools commonly used to check alignment.
- Tell how to set an alignment screw to prevent its movement.

Lesson 5: Checking and Test Running

Topics

Electric Power Connections; Hydraulic and Pneumatic Power Connections; Coolant Systems for Equipment; Equipment Safety Devices; Settings and Adjustments; Equipment Operating Pressure; Limit Switches and Stops; Checking the Equipment Setup; Initial Running under Power; Test Run Guidelines; Making the Test Run; Safety Precautions for Installing Equipment

Objectives

- Explain how to test for the presence of moisture in electrical equipment.
- Tell what device is commonly used to prevent excessive pressure in a hot water heater.
- Explain the function of a pressure regulating valve.
- List the steps to take before initial equipment startup.
- Tell the usual cause of excessive temperature during equipment startup.

Mechanical Drive Maintenance

Course 341: Mechanical Drive Maintenance

Covers alignment, particularly coupling alignment. Includes installation and maintenance of mechanical drives, from chain drives to enclosed gear drives.

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

Lesson 1: Chain Drives

Topics

Types of Chain Drive; Installing and Aligning Shafts; Mounting the Drive Sprockets; Mounting the Drive Chain; Test Running with No Load; Lubrication Recommendations; Lubrication Methods or Types; Test Running with Full Load; Preventive Maintenance of Chain; Care of Stored Chain; Troubleshooting Chain Drives; Chain Drives and Safety

Objectives

- List four types of chain drives.
- Describe the procedure for aligning the driving and driven shafts.
- Distinguish between bored sprockets and bushed sprockets and tell how each is mounted.
- Tell how a drive chain is mounted on the sprockets.
- List four methods of lubrication for chain drives.
- Explain both no-load and full-load test running procedures.
- Describe the causes of fatigue breaks, tensile breaks, rapid chain wear, roller wear, and side plate spreading.

Lesson 2: Belt Drives

Topics

Types of Belt Drive; Installing and Aligning Drives; Mounting Sheaves and Pulleys; Installation of V-belts; Adjusting the Sheave Centers; Use of Idler Sheaves; Adjusting V-belt Tension; Test-Running and Initial Run-in; Flat Belt Drives; Positive Belt Drives; Preventive Maintenance of Belts; Operating Environment for Belts; Troubleshooting Belt Drives; Belt Drives and Safety

Objectives

- List the three general types of belt drive and explain how they work.
- Tell how sheaves and pulleys are mounted and aligned on their shafts.
- Explain why all the belts in a multi-belt drive must be replaced at the same time.
- Describe two ways of taking up slack in a stretched V-belt.
- List three ways of splicing the ends of a flat belt together.
- Differentiate between the way positive-drive belts and other types of belt transmit power.

Lesson 3: Open Gear Drives

Topics

Makeup of a Gear Train; Terminology of Gearing; Aligning the Shafts; Handling the Gears; Preparing the Shafts; Mounting the Gears; Checking the Gear Alignment; Lubricating Open Gearing; Preventive Maintenance of Gearing; Troubleshooting Open Gear Drives; Open Gearing and Safety

Objectives

- Explain why open gearing requires special provisions for feeding lubricating oil to its parts.
- Describe how to align parallel shafts, intersecting right-angle shafts, and nonintersecting right-angle shafts.
- Describe the procedure for aligning worm gearing.
- List some of the problems a visual inspection of gearing can uncover.
- Describe the appearance and causes of wear, abrasion, corrosion, scoring, pitting, spalling, cold flowing, fatigue breaks, and cracked rims and webs.

Lesson 4: Enclosed Gear Drives

Topics

Installation of Enclosed Drives; Preparing the Drive Foundation; Installing the Gear Drive and Accessories; Lubricating; Test Running; Run-in; One-Week Check; Thirty-Day Check; Storage; Preventive Maintenance; Troubleshooting Enclosed Gear Drives

Objectives

- Tell how an enclosed gear drive should be mounted on the floor.
- Tell how an enclosed gear drive should be mounted on the framework of a driven machine.
- Describe the two methods of lubrication used in enclosed gear drives.
- Explain what should be done during the initial run-in, the one-week check, and the thirty-day check.
- List four steps you should take to protect an enclosed gear drive that is to be put into storage.
- Identify typical nameplate data.

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Mechanical Drive Maintenance

Lesson 5: Drive Couplings

Topics

Introduction to Couplings; Installing Standard Shaft Couplings; Aligning Shaft Couplings; Precision Coupling Alignment; Coupling Expansion Allowance; Lubrication of Couplings; No-Load Testing; Installing Spacer Couplings; Installing Floating Shaft Couplings; Installing Universal Joints; Preventive Maintenance of Couplings; Drive Couplings and Safety

Objectives

- List three purposes of a coupling.
- List the three basic types of coupling.
- Explain how to check both the angular and the parallel alignment of shafts.
- Tell how a dial indicator is used in precision coupling alignment.
- Calculate shim thickness required to align couplings in an angular plane.
- Distinguish between couplings that need lubrication and those that do not.
- Describe how shaft couplings, spacer couplings, floating shaft couplings, and universal joints are installed.

Mechanical and Fluid Drive Systems

Course 342: Mechanical and Fluid Drive Systems

Covers further details of drive maintenance, including brakes, clutches, and adjustable-speed drives. Also covers maintenance and troubleshooting of fluid drives and package drive systems.

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

Lesson 1: Mechanical Brakes and Clutches

Topics

Basic Types of Mechanical Clutch; Installing a Mechanical Clutch; Preparing the Shafting; Installing the Clutch Body; Initial Lubrication of Clutch; Providing the Power Supply; Making Initial Adjustments; Test Running with No Load; Making Final Adjustments; Test Running with Full Load; Installing a Mechanical Brake; Preventive Maintenance; Operating Environment; Troubleshooting Brakes and Clutches; Brakes, Clutches, and Safety

Objectives

- Explain how friction-type and jaw-type clutches differ in construction.
- Name the precautions that should be taken when mounting body on a shaft.
- Explain how to test-run a mechanical clutch with no load.
- Explain how to install a mechanical brake.
- Describe the results of improper alignment between driving and driven shafts.
- Identify the problems that may be indicated by chatter and excessive noise.

Lesson 2: Electric Brakes and Clutches

Topics

Types of Brakes and Clutches; Single-Disc Friction Clutch; Multiple-Disc Friction Clutch; Tooth-Type Clutch; Hysteresis Clutch; Eddy-Current Clutch; Magnetic Particle Clutch; Clutch Operation; Clutch Torque; Heat Dissipation; Response Time; Preventive Maintenance; Wiring Brakes and Clutches; Troubleshooting Brakes and Clutches; Brakes, Clutches, and Safety

Objectives

- Describe how single-disc and multiple-disc friction clutches operate.
- Explain how the principle of hysteresis is applied in electric clutches.
- List the three basic components of magnetic particle clutch.
- Differentiate between the static torque, pickup torque, and average torque of a clutch.
- Identify the problems that may arise in a clutch if its heat is not dissipated.
- Define decay time, pull-in time, and response time.

Lesson 3: Adjustable-Speed Drives

Topics

Principles of Adjustable-Speed Drives; Two Basic Designs; Open-Type Adjustable-Speed Drive; Environment for Open-Type Drive; Enclosed-Type Adjustable-Speed Drive; Storage of Enclosed Drives; Protection of Enclosed Drives; Handling an Enclosed Drive; Preparing the Drive Shafting; Leveling an Enclosed Drive; Eliminating Vibration in Drives; Initial Lubrication of Drive; Test-Running; Preventive Maintenance of Drives; Troubleshooting Adjustable-Speed Drives; Adjustable-Speed Drives and Safety

Objectives

- List the precautions necessary to provide extra protection for open-type drives.
- Describe how to install an enclosed-type drive on a concrete floor.
- Explain how to prepare the shafting when installing a new enclosed drive.
- Describe the initial lubrication of new adjustable-speed drives.
- Describe how to test-run an adjustable-speed drive under no load and full load conditions.
- Name some of the safety rules for working on an adjustable drive.

Lesson 4: Fluid Drives

Topics

Principle of Fluid Drives; Operation of Fluid Coupling; Constant-Speed Couplings; Variable-Speed Couplings; Operation of Torque Converter; Torque Converter Modifications; Coupling Drive Arrangements; Installing Fluid Couplings; Installing Large Fluid Couplings; Installing Torque Converters; Preventive Maintenance of Couplings; Fluid Couplings and Safety

Objectives

- Explain how a fluid drive works.
- Describe how constant-speed couplings differ from variable-speed couplings.
- Trace the fluid path through a torque converter using either a drawing or a cutaway.
- Describe the various ways of mounting a fluid coupling.
- Explain how to cool the fluid in large couplings.
- Discuss preventive maintenance procedures for couplings.

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Mechanical and Fluid Drive Systems

Lesson 5: Complete Drive Systems

Topics

Introduction; Drive with Coupling and Roller Chain; Drive with Two Flexible Couplings; Drive with Right-Angle Drive Shafts; Drive with Adjustable-Speed Belt; Shaft-Mounted Drive; Installing a Drive System; Protection of Drives; Test Running a Drive; Preventive Maintenance of Drives; Troubleshooting a Drive System; Packaged Drives and Safety

Objectives

- List the components used in a typical drive system.
- Name the part of a drive system in which most of the speed reduction occurs.
- Describe the construction and operation of a shaft-mounted drive.
- List the protective devices for a drive.
- Explain the proper maintenance procedures for a drive system.
- Describe the steps to be taken when troubleshooting a drive system.

Bearing and Shaft Seal Maintenance

Course 343: Bearing and Shaft Seal Maintenance

Covers plain bearings, their parts, dimensions, functions, and relining techniques. Continues with installation and replacement of antifriction bearings. Also covers linear motion bearings and shaft seals.

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

Lesson 1: Plain Bearings

Topics

Plain Bearings; Measuring Plain Bearing Dimensions; Measuring Clearances; Plain-Bearing Linings; Bearing- and Lining-Material Characteristics; Prefabricated Bearing Liners; Poured Bearing Liners; Pouring the Babbitt; Cleaning the Bearing; Measuring and Inspecting the Shaft Journal; Installing Split-Housing Bearings; Deformation; Lubrication of Plain Bearings; Oils as Lubricants; Greases as Lubricants; Initial Run-in; Scheduling Inspections; Removing Faulty Bearings; Signs of Overheating; Troubleshooting

Objectives

- Name the important dimensions of a plain bearing.
- State the source for learning the proper running clearance in a plain-bearing installation and describe how to measure running clearance.
- State the characteristics of bearing and liner material and explain how they influence the choice of bearing for a given application.
- Discuss the steps involved in fabricating a poured babbitt bearing liner and obtaining the correct finished-bore dimensions.
- State the purpose and general principles of plain-bearing installation.
- List important factors to consider when selecting the correct lubricant for a given plain-bearing installation.
- Identify the symptoms of bearing trouble and describe how to remedy each situation.

Lesson 2: Installing Antifriction Bearings

Topics

Preparatory Cleanup; Inspecting the Bearing; Inspecting the Shaft Bearing Seat; Bearing Seating Methods; Cold Mount Techniques; Cold Mount Using Split Tapered Adapter; Temperature Mount; Mounted Internal Clearance Adjustment; Lubrication; Inspection and Maintenance

Objectives

- Describe proper procedures in handling, storing, cleaning, and inspecting antifriction bearings.
- Explain how to measure, inspect, and condition a shaft bearing seat prior to installing a new bearing.
- Tell where pressure should be applied to force a ball bearing onto a shaft.
- Name the two dimensions that are important in mounting a tapered-bore bearing on a shaft.
- Describe the steps involved in correctly seating an antifriction bearing.
- Discuss how an adapter is used to mount a bearing on a shaft.
- Describe the steps to take when using a hot-oil bath to heat a bearing for mounting.
- Name the three major signals of bearing failure in antifriction bearings.

Lesson 3: Removing and Replacing Antifriction Bearings

Topics

Preparation; Removing Retainers and Seals; Press or Impact Bearing Removal; Bearing Removal with Mechanical Pullers; Using Heat to Remove Bearings; Cleaning Used Bearings; Inspecting Used Bearings; Storing Bearings During Machine Overhauls; Replacing the Bearing; Conditioning Shaft and Housing Bore Surfaces; Replacement of Auxiliary Parts; Safety Measures

Objectives

- Describe the correct procedures for removing bearing seals and retaining devices from a bearing assembly.
- Describe the impact bearing removal technique.
- Explain how to use an aluminum heating ring to mount and dismount the inner ring of a cylindrical roller bearing.
- Discuss the steps involved in inspecting and cleaning used bearings.
- Describe the procedures for remounting sound used bearings.
- Explain how to replace a shaft seal.
- List the safety precautions that are essential to working with bearings.

Lesson 4: Mounted Antifriction Bearings

Topics

Bearing Types and Applications; Seals; Housings; Bearing Inserts and Mounting Devices; Shaft Misalignment; Installing Mounted Bearings; Pillow Block Lubrication; Regular Maintenance

Objectives

- Name the three major types of housings or mounts for bearings.
- Name the major components of a mounted antifriction bearing.
- Describe the two basic types of bearing seal and name the advantages of each.
- List the different methods of securing insert bearings to the shaft and describe the mounting methods involved.
- Discuss shaft alignment and describe bearing design factors that compensate for misalignment.
- Explain why most bearing/shaft assemblies have one free and one fixed bearing.
- List factors to consider when selecting bearing lubricants for pillow blocks.

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Bearing and Shaft Seal Maintenance

Lesson 5: Linear Motion Bearings and Shaft Seals

Topics

Linear Motion Bearings; Ball Bearing Screw Operation; Ball Bearing Screw Design and Performance; Ball Bearing Screw Support; Preparing for installation; Installing the Ball Bearing Screw; Ball Bearing Screw Lubrication; Shaft Seals; Shaft Seal Operation; Shaft Seal Selection; Effects of Temperature; Effects of Speed; Shaft and Housing Design; Shaft Seal Installation; Shaft Seal Removal; Troubleshooting Shaft Seals

Objectives

- Name the major components of a ball bearing screw.
- Describe the major differences between a ball bearing screw and an acme screw.
- Describe the main purpose of a ball bearing screw and give an example of a typical application.
- Describe the installation procedures for a ball bearing screw.
- Name the differences between contact and labyrinth seals and explain what creates the sealing action in each.
- List the factors that determine the choice of shaft seal.
- Describe how to install a lip seal on a shaft, including shaft preparation.
- Name the major problem that arises with lip seals and list at least four conditions that can cause it.

Pump Installation and Maintenance

Course 344: Pump Installation and Maintenance

Covers basic pumping concepts. Describes required maintenance of packing and seals. Covers maintenance and overhaul of centrifugal pumps. Concludes with maintenance of rotary pumps.

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

Lesson 1: Basic Pumping Concepts

Topics

Force; Work; Power; Horsepower; Energy; Velocity and Acceleration; Static Suction Lift; Pressure Losses; Available NPSH; Required NPSH; Checking Pump Capacity; Pumping Hot Water; Computing Pump Power Requirements; Effects of Operational Factors; Priming a Pump

Objectives

- Compute the amount of work done when given values for force and distance.
- Name the two types of energy.
- Check pump capacity by determining NPSHA of the system.
- Compute the brake horsepower required to drive a pump under given conditions.
- Explain how to prime a fluid-handling pump.

Lesson 2: Maintaining Packing and Seals

Topics

Uses of Packing and Seals; Two Types of Seals; Packing; Selecting Packing Material; Removing Old Packing; Installing New Packing; Packing Precautions; Mechanical Seals; Mechanical Seals Versus Packing; Types of Mechanical Seals; Installing Mechanical Seals; Maintaining Packing and Seals; Troubleshooting Packing and Seals

Objectives

- Identify the two major functions of packing and seals.
- Explain selection and installation of packing rings on a pump shaft.
- Identify the components of typical mechanical seals.
- Name at least three advantages of mechanical seals over packing.
- Describe how to install a mechanical seal on a pump shaft.
- Discuss the care and maintenance of packing and seals.

Lesson 3: Maintaining Centrifugal Pumps

Topics

Installing the Pump; Preparing the Foundation; Fabricated Steel Baseplates; Leveling the Baseplate; Checking Shaft Alignment; Grouting the Baseplate; Mounting Pump and Motor Separately; Compensating for Heat; Installing Auxiliary Pump Drives; Maintaining Centrifugal Pumps; Inspecting Packing and Seals; Inspecting Bearings; Motor and Drive; Avoiding Common Pump Problems; Cavitation; Ring Seizure; Overheating; Pump Operation; Scheduling Maintenance; Troubleshooting

Objectives

- Explain how to align and level a pump on its base.
- Explain the needs for and uses of auxiliary pump drives.
- Identify the major symptom of faulty packing.
- Identify the major symptom of cavitation on a pump impeller.
- Describe the causes and remedies of common centrifugal pump problems.
- Tell how to conduct a periodic inspection of the major pump components.

Lesson 4: Overhauling Centrifugal Pumps

Topics

Preparation; Work Areas and Rigging; Moving a Pump; Disassembling a Pump; Inspecting Pump Parts; Checking Clearances; Reassembling a Pump; Reinstalling a Pump

Objectives

- Describe the procedures involved in disassembling, inspecting, reassembling, and reinstalling a centrifugal pump.
- Explain how to check the runout of a pump shaft.
- Explain how to check the clearances between stationary rings and the impeller or rotating rings.
- Describe how to make a new housing gasket.

Lesson 5: Maintaining Rotary Pumps

Topics

Types of Rotary Pumps; Gear-Type Rotary Pumps; Vane-Type Rotary Pumps; Axial Flow Pumps; Installing Rotary Pumps; Aligning Pump and Piping; Direction of Rotation; Pump Start-Up; Maintaining Rotary Pumps; Scheduling Inspections and Maintenance; Troubleshooting Rotary Pumps

Objectives

- Identify the differences between the different types of rotary pumps.
- Trace the path of fluid through a rotary pump.
- Identify the major problem areas in a rotary pump.
- Explain how to troubleshoot some of the common problems of rotary pumps.
- Create a maintenance schedule for inspections and a record-keeping log.

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Maintenance Pipefitting

Course 345: Maintenance Pipefitting

Covers components and terminology used in piping systems. Also covers terminology, measurement, and maintenance of threaded, welded, and plastic piping systems. Explains the use of pipefitting accessories—supports, traps, filters and strainers, and expansion joints.

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

Lesson 1: Piping Dimensions and Terminology

Topics

Piping Standards; Basic Pipe Dimensions; Piping System Symbols; Pipe Fittings; Flanges; Flange Facings and Finishes; Using Dimensional Tables; Calculating Lengths from Existing Pipes; Straight Offsets; Rolling Offsets

Objectives

- State whether ID or OD identifies a given nominal pipe size.
- Given a nominal pipe size and a copy of the American Standard Code for Pressure Piping, find the wall thickness of a pipe of a given schedule number.
- Name at least four kinds of pipe fittings.
- Given a schematic drawing of a piping system, identify all fittings used in the system.
- Given a drawing showing three lengths of pipe with and without fittings installed, correctly name the application dimension for measuring the pipe length.
- Given a schematic drawing showing two parallel horizontal pipe runs with a 45° run connection, identify the travel, set, and face-to-face length.

Lesson 2: Threaded Piping Systems

Topics

Threads; Thread Terminology; Measuring Pipe Threads; Threaded Pipe Fittings; Measuring Pipe for Installation; Cutting Pipe; Threader and Dies; Threading Pipe; Finishing the Pipe; Inspecting Old Threads; Applying Sealants; Assembly of Components; Testing the System; Troubleshooting/ Emergency Repairs; Replacement

Objectives

- Given a descriptive number, identify the pipe size, thread type, and number of threads per inch on a threaded pipe.
- Given a length of unthreaded pipe and required thread specifications, thread one end of the pipe to meet the specifications.
- Given a length of threaded pipe and two threaded fittings, prepare the parts, apply the proper compound, and assemble the components.
- State the important parts of a pipe thread.
- Given actual dimensions for travel and set of a threaded pipe and fitting assembly, use established dimensional tables to compute the total length of replacement pipe needed.

Lesson 3: Welded Piping Systems

Topics

Welds Based on Type of Connection; Fittings for Welded Pipe Systems; Welding Rings; System Alignment; Squareness; Aligning Fittings; Hole Positioning; Measurements; Preparing the Work; Squaring the Flange; Weld Cracks; Inspection; Repairs

Objectives

- Explain what steps to take to prepare lengths of pipe for butt and fillet welding.
- Name the welding ring material used with stainless steel or nickel alloy piping.
- Explain squareness and its importance in a welded piping system.
- Name the major assembly considerations when fabricating flanged connections for a rolling offset installation.
- Given a schematic drawing of this installation, compute the hole compensation angle to be used when positioning the flange for welding.
- Name at least one accessory used to help align two sections of pipe for welding.
- Given a length of pipe and a slip-on flange with a raised face, align and weld the pipe and flange.

Lesson 4: Plastic Piping Systems

Topics

Thermoplastic Pipe Materials; Advantages of Thermoplastic Materials; Disadvantages of Thermoplastic Materials; Standards for Thermoplastic Pipe; Thermosetting Pipe Materials; Fluids Carried by Thermosetting Pipe; Advantages of Thermosetting Materials; Disadvantages of Thermosetting Materials; Standards for Thermosetting Pipe; Installing Thermoplastic Pipe; Installing Thermosetting Pipe; Troubleshooting Plastic Piping Systems

Objectives

- Name the materials used for plastic pipes and fittings.
- Name at least one advantage of plastic piping.
- Name the two most common materials used to make thermosetting plastic pipe.
- Given two lengths of thermosetting plastic pipe, demonstrate how to join then with a bell and spigot joint.
- Name at least one limitation of plastic piping.
- Demonstrate how to align and install fittings on a length of plastic pipe.

Maintenance Pipefitting

Lesson 5: Pipefitting Accessories

Topics

Hangers and Supports; Special Mountings; Steam Traps; Types of Traps; Steam Trap Installation; Trap Cleaning; Filters, Strainers, and Separators; Installation; Cleaning; Expansion Joints and Fittings; Expansion Joint Applications; Expansion Joint Selection and Installation; Maintenance

Objectives

- Name the three classes of piping supports and hangers.
- Explain which two types of pipe hangers are most often used to reduce line vibration and shock.
- Explain the factors to be considered when installing pipe hangers for different applications.
- Name the piping system components used to compensate for pipe length changes due to temperature changes.
- Explain the factors to be considered when locating (spacing) pipe hangers in a system.
- Name two types of steam traps and identify the major consideration in locating them.
- Explain the purpose of a line filter.

Tubing and Hose System Maintenance

Course 346: Tubing and Hose System Maintenance

Covers tubing specifications, materials, and fittings. Explains procedures used for handling, bending, cutting, and installing tubing. Gives basics of tubing in a hydraulic system. Describes hose systems and their functions. Concludes with gaskets, sealants, and adhesives.

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

Lesson 1: Tubing Fundamentals

Topics

Tubing or Pipe?; Tubing Specifications; Copper Water Tubing; Other Tubing Materials; Fittings; Handling Tubing; Cutting Tubing; Sawing Tubing; Filing and Deburring Tubing; Calculating Tubing Length; Bending Tubing

Objectives

- Compare and contrast tubing and pipe.
- List factors to be considered when selecting tubing for a specific application.
- State a common application of various tubing materials.
- Describe various fittings and tell how to select the proper fitting for a given tube.
- Tell why is it sometimes necessary to anneal tubing.
- List the steps to follow when cutting, sawing, and deburring tubing.
- Explain how to calculate tubing length accurately.
- List the steps involved in bending a given length of tubing.

Lesson 2: Installing Tubing

Topics

Selecting Tubing Material; Determining Tubing Size; Soldered Fittings; Brazed Fittings; Flared Fittings; Flaring Tubing; Using Flaring Tools; Installing Flared Fittings; Flareless Fittings; Installing Flareless Compression Fittings; Tubing Supports and Clamps; Tubing Maintenance and Troubleshooting

Objectives

- Define the service conditions that must be taken into account when selecting tubing.
- List the properties and typical uses of various types of fittings.
- Explain the procedures involved in soldering and brazing.
- Name several types of flaring tools and explain how they are used.
- Explain how to install flared and flareless fittings.
- Tell how and why tubing systems should be well supported.
- List common causes of tubing system problems and their solutions.

Lesson 3: Hydraulic Tubing Systems

Topics

Force and Pressure; Hydraulic Fluids; Basic Hydraulic Circuitry; Hydraulic Line Components; Control Devices; Selecting Tubing and Fittings; Tubing Sizes; Fittings; Installing Hydraulic Tubing Systems; Maintaining Hydraulic Tubing Systems; Troubleshooting Hydraulic Tubing Systems

Objectives

- Explain the principles of force, pressure, and area as applied to hydraulics.
- Discuss hydraulic fluids, hydraulic circuits, and hydraulic line components.
- Explain how to select the proper tubing and fittings for hydraulic systems.
- Describe maintenance and troubleshooting procedures for hydraulic tubing systems.

Lesson 4: Hose Systems

Topics

Hose Selection Factors; Hydraulic Hose; General Applications; Hose Construction; Hose Fittings; General Fitting Classifications; Measuring Assembly Length; Calculating Hose Length for Bends; Installing Hose Systems; Testing and Inspecting Hose; Maintenance and Troubleshooting

Objectives

- Discuss the three most common applications for hoses in industry.
- Describe hose fitting classifications and installation techniques.
- Explain how to calculate hose lengths for bends.
- Describe the methods of testing, inspection, and maintaining hose.

Lesson 5: Gaskets, Sealants, and Adhesives

Topics

Gaskets; Gasket Materials; Critical Dimensions; Preparing to Install a Gasket; Making a Gasket; Preparing the Contact Surfaces; Cleaning Flange Surfaces; Coatings; Installing the Gasket; Tightening the Joint; Replacing Old Gaskets; Gasket Ropes, Tapes, and Strips; Sealants and Adhesives

Objectives

- Identify the types and uses of gasket materials.
- Name the critical dimensions of a flanged pipe joint gasket.
- List and explain the three characteristics of contact surfaces that must be considered prior to the installation of a gasket.
- Explain the uses of gasket coatings, tapes, and strips.
- Describe the application of sealants and adhesives in gasket joints.

Valve Maintenance and Piping System Protection

Course 347: Valve Maintenance and Piping System Protection

Covers maintenance and operation of gate, globe, ball, plug, check, and special-purpose valves. Details actuators and various accessories. Explains valve selection based on application. Describes methods of protecting piping systems.

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

Lesson 1: Valve Maintenance

Topics

Valve Materials; Threaded Connections; Welded and Brazed Connections; Flanged Connections; Valve Installation; Repairing Gate Valves; Repairing Globe and Angle Valves; Repairing Ball Valves; Maintaining Plug Valves; Maintaining Check Valves; General Maintenance

Objectives

- Discuss the factors that affect the selection of valve materials.
- Describe the various methods of connecting valves to piping.
- Identify the various types of common valves and the operating characteristics of each.
- Explain general maintenance and repair procedures for different types of valves.

Lesson 2: Special Valves

Topics

Special Valves; Butterfly Valves; Butterfly Valve Installation; Butterfly Valve Repair; Diaphragm Valves; Diaphragm Valve Installation; Diaphragm Valve Repair; Pop Safety Valves; Pop Safety Valve Installation; Pop Safety Valve Repair; Relief Valves; Safety Relief Valves; Safety Relief Valve Installation; Safety Relief Valve Repair; Pressure-Reducing and Regulating Valves; Installation and Repair; Quick-Opening Valves

Objectives

- Identify several types of special valves and the operating characteristics of each.
- Discuss the installation, maintenance, and repair of special valves.

Lesson 3: Actuators and Accessories

Topics

Valve Actuators; Diaphragm Actuators; Piston Actuators; Electric Actuators; Actuator Installation; Actuator Maintenance and Repair; Bourdon Tube; Bimetallic Gauge; Bellows Gauge; Flowmeters; Rotating Unions; Accumulators; Air Receivers

Objectives

- Explain the function and operation of a valve actuator.
- Identify various types of valve actuators and describe the installation. maintenance, and repair of each.
- Discuss the operating characteristics of various accessories, including gauges, meters, accumulators, and air receivers.

Lesson 4: Valve Selection

Topics

Application Considerations; Studying the Total System; Valve Applications; Valve Materials; Valve Identification; Soldered Valve Connections; Threaded Valve Connections; Flanged Valve Connections; Tool Selection; Valve Location; Positioning the Valve

Objectives

- Name the five major uses of valves in piping systems and identify the types of valves best suited for each.
- Identify and explain the factors that determine the selection of a valve for a given application.
- Identify various valve markings and symbols.
- Describe several types of valve-to-pipe connections.
- Discuss the selection and proper use of tools in valve installations.
- Explain the importance of the correct installation of valves in well-chosen locations.

Lesson 5: Piping System Protection

Topics

Protecting Hot Pipelines; Heat Conduction; Heat Convection; Heat Radiation; Installing Insulation; Maintaining Insulation; Tracing; Installing Steam Tracers; Electric Tracing; Tracing Valves and Fittings; Protection from Freezing; Protection from Corrosives; Active Protection; Passive Protection; Inspection of Piping Protection; Hangers and Supports

Objectives

- Describe the methods by which heat transfer occurs.
- Discuss the methods of tracing process lines.
- Explain the various methods of protecting piping systems from heat, cold, and corrosion.
- Discuss the installation, inspection, and maintenance of insulation and other forms of piping system protection.

P: 847.808.4000 • F: 847.808.4003 • www.tpctraining.com