



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.

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 programmed control circuit.

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.