

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.

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.

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; Amplidyne; 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 value 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 is important.
- List the common causes of excessive brush sparking.