

DC Equipment and Controls

Course 206: DC Equipment and Controls

Covers DC power applications in industry, types of DC generators, operating characteristics of DC motors, DC armature principles, and armature maintenance and repair. Includes types of DC relays, DC controllers, overspeed and overload protection, drum and reversing controllers, dynamic braking, DC power supplies, diodes, semiconductors, SCR principles, and DC maintenance practices.

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



Lesson 1: DC Power in Industry

Topics

Advantages of Direct Current; DC Generators; Rectifiers; DC Motors; SCR Speed Control; Storage Batteries; Charging Storage Batteries; Electroplating; Electropolishing; Electroforming; Electrolytic Refining; Electrolytic Furnaces; Arc Welding

Objectives

- List the advantages of dc over ac.
- List the brush problems caused by eddy currents.
- Name three types of batteries commonly used in the plant.
- Explain how the electroplating process works.
- Explain the difference between straight polarity and reversed polarity in arc welding.

Lesson 2: DC Electromagnets

Topics

Magnets and Magnetic Materials; Magnetic Forces; Magnetic Fields; Effect of Distance on Magnetic Field Strength; Magnetic Shielding; Solenoids; U-Shaped Magnets; Reducing the Effects of Residual Magnetism; Uses for Solenoids; Choosing the Right Solenoid; Causes of Solenoid Problems; Relays; Polarized Relays; Protecting Relay Contacts

Objectives

- State the definition of residual magnetism.
- Explain the effects of distance on magnetic field strength.
- Discuss the characteristics and uses of solenoids.
- Discuss the characteristics of relays.

Lesson 3: DC Generators

Topics

Magnets and Magnetic Materials; Magnetic Forces; Magnetic Fields; Effect of Distance on Magnetic Field Strength; Magnetic Shielding; Solenoids; U-Shaped Magnets; Reducing the Effects of Residual Magnetism; Uses for Solenoids; Choosing the Right Solenoid; Causes of Solenoid Problems; Relays; Polarized Relays;

Objectives

- Explain the function of each of the main parts of the dc generator.
- Explain how to increase the number of pulses during each rotation of an armature.
- Demonstrate how to combine the shunt field and series field to produce a compound generator.
- State the reasons why electrical losses, magnetic losses, and mechanical losses occur in the dc generator.

Lesson 4: DC Motors

Topics

Principles of DC Motors; Counter-EMF (CEMF); Armature Reaction; Self-Induction and Commutation; Interpoles; Torque in DC Motors; Factors Determining Torque; Work and Power; Speed Regulation; Kinds of DC Motors; Shunt Motors; Torque Variation in a Shunt Motor; Effects of an Open-Shunt Field; Series Motor; Compound Motors; Cumulative Compound Motors; Differential Compound Motors

Objectives

- Explain what happens during self-induction and commutation.
- Define CEMF.
- State the difference between speed regulation and speed control.
- Name the kinds of dc motors.
- Explain the different operating characteristics of series, shunt, and compound motors.

Lesson 5: DC Armatures

Topics

Kinds of DC Armatures; DC Armature Windings; Simplex-Lap Windings; Simplex-Wave Windings; Armature Losses; Copper Loss; Eddy-Current Loss; Hysteresis Loss; Commutation; Armature Maintenance; Locating Armature Problems

Objectives

- Name the basic parts of an armature assembly.
- Describe the main differences between a lap winding and a wave winding.
- List the characteristics of a single-reentrant simplex-lap winding.
- State the definition of copper loss, eddy-current loss, and hysteresis loss.
- Demonstrate how to perform preventive maintenance on an armature.

Lesson 6: DC Relays

Topics

Relay Operating Characteristics; Overload Relays; DC Motor Acceleration; Shunt Relays; Series Lockout Relays; Double-Coil Series Lockout Relays; Two-Coil Lockout Relays; Inductive Time-Delay Relays; Magnetic Blowout Coils; Dynamic Braking; Electrically Operated Brakes

Objectives

- Name three factors that determine the performance and reliability of a relay.
- Name the six types of commonly used relays.
- Explain the operation of each type of relay.
- Explain dynamic braking.
- Describe how a disc brake is attached to a motor.

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Lesson 7: DC Controllers

Topics

Factors Affecting Motor Speed; Classification by Performance; Low-Voltage Protection; Overvoltage Protection; Low-Voltage Release; Overload Protection; Temperature Compensation; Controller Overload Reset; Manual Starters; Magnetic Controllers; Drum Controller

Objectives

- List the kinds of functions performed by motor-control devices.
- Name the types of motor controllers and discuss their operating characteristics.
- Explain how each of the three kinds of thermal overload relays works.
- Name the kinds of resets for overload relays.

Lesson 8: DC Power Supplies

Topics

Electron Emission; Electron Tubes; Vacuum-Tube Diode; Vacuum-Tube Diode Rectifiers; Semiconductors; Why Semiconductors Fail; Comparing Generators to Rectifiers; Automotive AC-DC Power Supply; Checking Diodes; Identifying Replacement Semiconductors

Objectives

- Discuss the operating principles of vacuum tubes and rectifiers
- Name the four types of filters commonly used in rectifier circuits.
- Identify a mercury-vapor diode.
- List common causes of semiconductor failure.
- State the criteria for selecting replacement semiconductors.

Lesson 9: Silicon Controlled Rectifiers

Topics

Principles of SCRs; Pulse Timing in DC Circuits; Trigger Pulses; SCR Control of Motors; DC Applications of SCRs; AC-DC Conversion; AC Applications of SCRs

Objectives

- State the definition of a silicon controlled rectifier.
- Explain how an SCR works.
- Explain how to increase the effective current and the power delivered to a motor by an SCR motor control.
- List four dc applications of SCRs.

Lesson 10: Maintenance of DC Equipment

Topics

Inspection; Maintaining Field Coils; Locating Problems in Field Coils; Short-Circuited Field Coils; Open Field Coils; Replacing Field Coils; DC Motor Controllers; Maintaining Relays; Relay Contacts; Maintaining DC Armatures; Commutation; Maintaining the Commutator; Brush Selection and Care; Setting Brushes

Objectives

- Explain how to test field coils to determine the condition of the insulation.
- List the signs of a short-circuited field coil in a machine.
- Explain how to replace a field coil in a machine.
- Discuss how to maintain relay control.
- Name the criteria for satisfactory commutation.