

MODULE OVERVIEW

This module introduces the principles of alternating current.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum* and *Electrical Level One*.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Calculate the peak and effective voltage or current values for an AC waveform.
2. Calculate the phase relationship between two AC waveforms.
3. Describe the voltage and current phase relationship in a resistive AC circuit.
4. Describe the voltage and current transients that occur in an inductive circuit.
5. Define inductive reactance and state how it is affected by frequency.
6. Describe the voltage and current transients that occur in a capacitive circuit.
7. Define capacitive reactance and state how it is affected by frequency.
8. Explain the relationship between voltage and current in the following types of AC circuits:
 - RL circuit
 - RC circuit
 - LC circuit
 - RLC circuit
9. Explain the following terms as they relate to AC circuits:
 - True power
 - Apparent power
 - Reactive power
 - Power factor
10. Explain basic transformer action.

PERFORMANCE TASKS

This is a knowledge-based module. There are no Performance Tasks.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Markers/chalk
Pencils and scratch paper

Appropriate personal protective equipment
Scientific calculator or trigonometric tables
Examples of capacitors
Examples of transformers
Module Examination**

** Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

Introduction to Electric Circuits, Latest Edition, New York: Pearson Educational Inc.

Principles of Electric Circuits, Latest Edition, New York: Pearson Educational Inc.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 17½ hours are suggested to cover *Alternating Current*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	Planned Time
Session I. Sine Wave Generation and Terminology	
A. Introduction	_____
B. Sine Wave Generation	_____
C. Sine Wave Terminology	_____
Session II. AC Phase Relationships	
A. AC Phase Relationships	_____
B. Nonsinusoidal Waveforms	_____
Session III. AC Circuits I	
A. Resistance in AC Circuits	_____
B. Inductance in AC Circuits	_____
Session IV. Capacitance	
A. Capacitance	_____
B. Calculating Equivalent Capacitance	_____
C. Capacitor Specifications	_____
D. Voltage and Current in a Capacitive AC Circuit	_____
E. Capacitive Resistance	_____
Session V. AC Circuits II	
A. LC and RLC Circuits	_____
B. Power in AC Circuits	_____
Session VI. Transformers	
A. Transformer Construction	_____
B. Operating Characteristics	_____
C. Turns and Voltage Ratio	_____
D. Types of Transformers	_____
Session VII. Review and Testing	
A. Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module introduces the operations and applications of various types of motors.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum*; *Electrical Level One*; and *Electrical Level Two*, Module 26201-08.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Define the following terms:
 - Controller
 - Duty cycle
 - Full-load amps
 - Interrupting rating
 - Thermal protection
 - NEMA design letter
 - Overcurrent
 - Overload
 - Power factor
 - Rated full-load speed
 - Rated horsepower
 - Service factor
2. Describe the various types of motor enclosures.
3. Explain the relationships among speed, frequency, and the number of poles in a three-phase induction motor.
4. Define percent slip and speed regulation.
5. Explain how the direction of a three-phase motor is changed.
6. Describe the component parts and operating characteristics of a three-phase wound-rotor induction motor.
7. Describe the component parts and operating characteristics of a three-phase synchronous motor.
8. Describe the design and operating characteristics of various DC motors.
9. Describe the methods for determining various motor connections.
10. Describe general motor protection requirements as delineated in the *National Electrical Code*[®] (*NEC*[®]).
11. Define the braking requirements for AC and DC motors.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Collect data from a motor nameplate.
2. Identify various types of motors and their application(s).
3. Connect the terminals for a dual-voltage motor.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Multimeters
Transparencies	Megger
Blank acetate sheets	Various types of motors, including:
Transparency pens	Three-phase wye/star and delta
Whiteboard/chalkboard	Two-phase double-voltage
Markers/chalk	Low-voltage and high-voltage
Pencils and scratch paper	Scientific calculator or trigonometric tables
Copy of the latest edition of the <i>National Electrical Code</i> [®]	Module Examinations*
	Performance Profile Sheet*

*Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to work with motors. Make sure that all trainees are briefed on appropriate safety procedures. Emphasize electrical safety.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference work is suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

National Electrical Code[®] *Handbook*, Latest Edition. Quincy, MA: National Fire Protection Association.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Motors: Theory and Application*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I through III. Introduction to Motors	
A. Introduction	_____
B. DC Motor Principles	_____
C. Types of DC Motors	_____
D. Alternating Current Motors	_____
E. Multi-Speed Induction Motors	_____
F. Variable-Speed Drives	_____
G. Laboratory	_____
Trainees practice identifying various types of motors and their applications.	
This laboratory corresponds to Performance Task 2.	
Sessions IV and V. Motor Enclosures	
A. Motor Enclosures	_____
B. NEMA Frame Designations	_____
C. Motor Ratings and Nameplate Data	_____
D. Laboratory	_____
Trainees practice collecting data from motor nameplates. This laboratory corresponds to Performance Task 1.	

Sessions VI and VII. Motor Connections and Installation

- A. Connections and Terminal Markings for AC motors
- B. NEC® Requirements
- C. Braking
- D. Motor Installation
- E. Laboratory

Trainees practice connecting the terminals for a dual-voltage motor. This laboratory corresponds to Performance Task 3.

Session VIII. Review and Testing

- A. Module Review
- B. Module Examination
 1. Trainees must score 70% or higher to receive recognition from NCCER.
 2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
- C. Performance Testing
 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
 2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

MODULE OVERVIEW

This module introduces the methods and procedures used in the handling and installation of different types of lamps and lighting fixtures.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Electrical Level One*; and *Electrical Level Two*, Modules 26201-08 and 26202-08.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Describe the characteristics of light.
2. Recognize the different kinds of lamps and explain the advantages and disadvantages of each type:
 - Incandescent
 - Halogen
 - Fluorescent
 - High-intensity discharge (HID)
3. Properly select and install various lamps in lighting fixtures.
4. Recognize and describe the installation requirements for various types of lighting fixtures:
 - Surface-mounted
 - Recessed
 - Suspended
 - Track-mounted
5. Recognize ballasts and describe their use in fluorescent and HID lighting fixtures.
6. Explain the relationship of Kelvin temperature to the color of light produced by a lamp.
7. Recognize basic occupancy sensors, photoelectric sensors, and timers used to control lighting circuits and describe how each device operates.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Read and interpret information given in lamp manufacturers' catalogs for one or more selected lamps.
2. Properly select and install lamps into lighting fixtures.
3. Install one or more of the following lighting fixtures and their associated lamps:
 - Surface-mounted
 - Recessed
 - Suspended
 - Track-mounted

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Prism
Copy of the latest edition of the *National Electrical Code*[®]
Examples of manufacturers' lighting and fixture catalogs

Examples of manufacturers' lighting fixture installation instructions
Examples of typical lighting plans and lighting fixtures schedule
Assortment of wire nuts
Electrical tape
Assortment of electric lamps, including:
Incandescent
Halogen
Fluorescent
High-intensity discharge (HID)
Electrician's toolbox

Assortment of lighting fixtures, including:
 Surface-mounted
 Recessed
 Suspended
 Track-mounted
 Ceiling fans/fixtures
 Assortment of electrical boxes, mounting hardware, and support hardware used to install different types of lighting fixtures

Assortment of track lighting components and accessories
 Hangers and supports used with suspended lighting fixtures
 Occupancy sensors and photosensors
 Timers
 Quick Quiz*
 Module Examinations**
 Performance Profile Sheet**

*Located in the back of this module.

**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to install lighting fixtures. Make sure that all trainees are briefed on appropriate safety procedures. Emphasize electrical safety.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

Lighting Handbook, Latest Edition, New York: Illuminating Engineering Society of North America (IESNA).

National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *Electric Lighting*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I and II. Introduction to Lighting	
A. Introduction	_____
B. Human Vision	_____
C. Light Characteristics	_____
D. Lamps	_____
E. Laboratory Trainees read and interpret information given in lamp manufacturers' catalogs for one or more selected lamps. This laboratory corresponds to Performance Task 1.	_____
F. Laboratory Trainees practice selecting and installing lamps in lighting fixtures. This laboratory corresponds to Performance Task 2.	_____
Session III. Ballasts and Fixtures	
A. Ballasts	_____
B. Lighting Fixtures	_____

Sessions IV and V. Lighting Fixture Installation

A. Surface-Mounted Lighting Fixtures

B. Recessed Lighting Fixtures

C. Suspended Lighting Fixtures

D. Track Lighting Fixtures

E. Laboratory

Trainees practice installing lighting fixtures and their associated lamps. This laboratory corresponds to Performance Task 3.

F. Controls for Lighting

G. Energy Management Systems

Session VI. Review and Testing

A. Module Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.

2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.

2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

MODULE OVERVIEW

This module introduces the methods and procedures used in conduit bending.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Electrical Level One; and Electrical Level Two*, Modules 26201-08 through 26203-08 and *NEC® Articles 342, 344, 352, and 358*.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Describe the process of conduit bending using power tools.
2. Identify all parts of electric and hydraulic benders.
3. Bend offsets, kicks, saddles, segmented, and parallel bends.
4. Explain the requirements of the *National Electrical Code® (NEC®)* for bending conduit.
5. Compute the radius, degrees in bend, developed length, and gain for conduit up to six inches.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Use an electric or hydraulic bender to bend a 1" conduit stub-up to an exact distance of 15¼" above the deck.
2. Make an offset in a length of conduit to miss a 10" high obstruction with a clearance between the obstruction and the conduit of not less than 1" nor more than 1½".
3. Make a saddle in a length of conduit to cross an 8" pipe with 1" clearance between the pipe and the conduit.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Pipe reamer
Transparencies	Shop towels
Blank acetate sheets	Brushes
Transparency pens	Felt-tip markers
Whiteboard/chalkboard	Portable mechanical conduit benders
Markers/chalk	Magnetic torpedo level
Pencils and scratch paper	EMT bending tools
Prism	Conduit bending protractor
Copy of the latest edition of the <i>National Electrical Code®</i>	Hickey bar
Hand bender and manufacturer's instructions	Tape measure
Lengths of ¾" rigid, EMT, and IMC conduit	Straightedge
Lengths of 1" rigid, EMT, and IMC conduit	Conduit leveling tools
Lengths of 2" rigid, EMT, and IMC conduit	PVC heater
Lengths of PVC conduit	Scientific calculator
Lengths of 8" pipe	Hacksaw
10" sample obstructions	Pipe vise
Bending charts to match mechanical, electrical, and hydraulic benders	Pipe cutter
PVC solvent cements	Cutting oil
End plugs for PVC conduit	Quick Quizzes*
	Module Examinations**
	Performance Profile Sheet**

* Located in the back of this module.

** Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to bend conduit. Make sure that all trainees are briefed on appropriate safety procedures. Emphasize hand tool and hydraulic safety.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

Benfield Conduit Bending Manual, 2nd Edition. Overland Park, KS: EC&M Books.

National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

Tom Henry's Conduit Bending Package (includes video, book, and bending chart). Winter Park, FL: Code Electrical Classes, Inc.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *Conduit Bending*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction to Conduit Bending	
A. Introduction	_____
B. NEC® Requirements	_____
C. Types of Bends	_____
D. The Geometry of Bending Conduit	_____
Session II. Mechanical Bending	
A. Mechanical Benders	_____
B. Mechanical Stub-ups	_____
C. Mechanical Offsets	_____
Session III. Electric and Hydraulic Conduit Bending	
A. Electric Conduit Benders	_____
B. Hydraulic Conduit Benders	_____
Sessions IV and V. Bending Techniques	
A. Segment Bending Techniques	_____
B. Tricks of the Trade	_____
C. Laboratory Trainees practice bending conduit. This laboratory corresponds to Performance Tasks 1–3.	_____
D. PVC Conduit Installations	_____
E. Bending PVC Conduit	_____

Session VI. Review and Testing

A. Module Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

MODULE OVERVIEW

This module introduces the trainees to the methods and procedures used in the selection and installation of pull and junction boxes.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Electrical Level One; and Electrical Level Two*, Modules 26201-08 through 26204-08.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Describe the different types of nonmetallic and metallic pull and junction boxes.
2. Properly select, install, and support pull and junction boxes and their associated fittings.
3. Describe the *National Electrical Code*[®] (NEC[®]) regulations governing pull and junction boxes.
4. Size pull and junction boxes for various applications.
5. Understand the NEMA and IP classifications for pull and junction boxes.
6. Describe the purpose of conduit bodies and Type FS boxes.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify various NEMA boxes.
2. Properly select, install, and support pull and junction boxes over 100 cubic inches in size.
3. Identify various conduit bodies and fittings.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Prism
Copy of the latest edition of the *National Electrical Code*[®]
Index cards
Examples of pull and junction boxes
Examples of different types of metallic and non-metallic boxes, device covers, and extension rings

Quick Quiz*
Examples of FS and FD boxes
Examples of different types of conduit bodies, pulling elbows, and entrance ells
Examples of different types of boxes used in hazardous locations
Seal fittings
Examples of fittings, including:
EMT
Rigid
Aluminum
IMC
Locknuts and bushings
Module Examinations**
Performance Profile Sheet**

* Located in the back of this module.

** Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to install junction boxes. Make sure that all trainees are briefed on appropriate safety procedures. Emphasize electrical safety.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference work is suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 12.5 hours are suggested to cover *Pull and Junction Boxes*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction to Pull and Junction Boxes	
A. Introduction	_____
B. Boxes for Damp and Wet Locations	_____
C. NEMA and IP Enclosure Classifications	_____
D. Laboratory Trainees practice identifying various NEMA boxes. This laboratory corresponds to Performance Task 1.	_____
E. Sizing Pull and Junction Boxes	_____
Session II. Conduit Bodies	
A. Conduit Bodies	_____
B. Handholes	_____
C. Laboratory Trainees practice identifying various conduit bodies and fittings. This laboratory corresponds to Performance Task 3.	_____
Sessions III and IV. Installing Pull and Junction Boxes	
A. Fittings	_____
B. Laboratory Trainees practice selecting, installing, and supporting pull and junction boxes. This laboratory corresponds to Performance Task 2.	_____
Session V. Review and Testing	
A. Module Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
C. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module introduces the methods and procedures used in conductor installations.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Electrical Level One; and Electrical Level Two*, Modules 26201-08 through 26205-08.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Explain the importance of communication during a cable-pulling operation.
2. Plan and set up for a cable pull.
3. Set up reel stands and spindles for a wire-pulling installation.
4. Explain how mandrels, swabs, and brushes are used to prepare conduit for conductors.
5. Properly install a pull line for a cable-pulling operation.
6. Explain how and when to support conductors in vertical conduit runs.
7. Describe the installation of cables in cable trays.
8. Calculate the probable stress or tension in cable pulls.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Prepare multiple conductors for pulling in a raceway system.
2. Prepare multiple conductors for pulling using a wire-pulling basket.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Setscrew cable grips
Transparencies	Swivel rope clevis
Blank acetate sheets	Basket-type pulling grips
Transparency pens	Cable cutters/stripping tools
Whiteboard/chalkboard	Self-contained hand-crank wire puller
Markers/chalk	Fish tape
Pencils and scratch paper	Power blower/vacuum fish tape system
Prism	Electrical cable puller
Copy of the latest edition of the <i>National Electrical Code</i> [®]	Cable grips
Several lengths of cable from No. 12 through 4/0 AWG	Clamps for supporting conductors
Lubricant	Insulating supports
Several types of pulling ropes	Manufacturers' catalogs for cable supports
Several different types and lengths of conductors	Cable manufacturers' literature
Measuring tape	Quick Quiz*
	Module Examinations**
	Performance Profile Sheet**

* Located in the back of this module.

** Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to prepare cable ends for installation. Make sure that all trainees are briefed on appropriate safety procedures. Emphasize hand tool safety. This module may require trainees to visit job sites. Ensure that all trainees are properly briefed on site safety procedures.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

Cable Installation Manual, Latest Edition. New York: Cablec Corp.

National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Conductor Installations*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction, Planning, and Setup	
A. Introduction	_____
B. Planning the Installation	_____
C. Setting up for Wire Pulling	_____
D. Laboratory Trainees practice preparing multiple conductors for pulling using a wire-pulling basket. This laboratory corresponds to Performance Task 2.	_____
Session II. Cable-Pulling Equipment	
A. Cable-Pulling Equipment	_____
B. High-Force Cable Pulling	_____
C. Mechanical Offsets	_____
Session III. Supporting and Pulling Cable	
A. Supporting Conductors	_____
B. Pulling Cable in Cable Trays	_____
C. Laboratory Trainees practice preparing multiple conductors for pulling in a raceway system. This laboratory corresponds to Performance Task 1.	_____
D. Physical Limitations of Cable	_____
E. Cable-Pulling Instruments	_____
Session IV. Review and Testing	
A. Module Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
C. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module introduces the methods and procedures used in the selection and installation of cable tray.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Electrical Level One; and Electrical Level Two*, Modules 26201-08 through 26206-08.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Describe the components that make up a cable tray assembly.
2. Explain the methods used to hang and secure cable tray.
3. Describe how cable enters and exits cable tray.
4. Select the proper cable tray fitting for the situation.
5. Explain the *National Electrical Code*[®] (*NEC*[®]) requirements for cable tray installations.
6. Select the required fittings to ensure equipment grounding continuity in cable tray systems.
7. Interpret electrical working drawings showing cable tray fittings.
8. Size cable tray for the number and type of conductors contained in the system.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Generate a list of materials for a cable tray layout. List all the components required, including the fasteners required to complete the system.
2. Join two straight, ladder-type cable tray sections together.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Splice plates
Transparencies	Alignment strips
Blank acetate sheets	Drop out plates
Transparency pens	H-bar
Whiteboard/chalkboard	Eight vertical adjustment splice plates
Markers/chalk	Cable tray supports, including:
Pencils and scratch paper	Beam clamps
Prism	Anchor clips
Copy of the latest edition of the <i>National Electrical Code</i> [®]	All-thread rods
Cable tray samples:	Nuts, bolts, washers, and other hangers
Metal ladder tray	Cable tray sections for cutting and offset
Metal trough tray	Felt-tip markers
Solid bottom tray	Hacksaw and blades
Tray covers	Protractor
Nonmetallic tray	Conventional square
Examples of cable tray failures	Quick Quiz*
Cable tray covers	Module Examinations**
	Performance Profile Sheet**

* Located in the back of this module.

** Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to work with cable tray. Make sure that all trainees are briefed on appropriate safety procedures. Emphasize electrical tool safety.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference work is suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 7.5 hours are suggested to cover *Cable Tray*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction to Cable Tray	
A. Introduction	_____
B. Cable Tray Loading	_____
C. Laboratory Trainees practice joining cable tray sections. This laboratory corresponds to Performance Task 2.	_____
D. Cable Tray Support	_____
Session II. Installation and Design	
A. Center Rail Cable Tray Systems	_____
B. NEC® Requirements	_____
C. Cable Installation	_____
D. Cable Tray Drawings	_____
E. Laboratory Trainees practice generating a list of materials for a cable tray layout. This laboratory corresponds to Performance Task 1.	_____
Session III. Pulling Cable, Safety, Review, and Testing	
A. Pulling Cable in Tray Systems	_____
B. Safety	_____
C. Module Review	_____
D. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
E. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module introduces the methods and procedures used when making conductor terminations and splices.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum*; *Electrical Level One*; and *Electrical Level Two*, Modules 26201-08 through 26207-08.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Describe how to make a good conductor termination.
2. Prepare cable ends for terminations and splices and connect using lugs or connectors.
3. Train cable at termination points.
4. Understand the *National Electrical Code*[®] (*NEC*[®]) requirements for making cable terminations and splices.
5. Demonstrate crimping techniques.
6. Select the proper lug or connector for the job.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Terminate conductors using selected crimp-type and mechanical-type terminals and connectors.
2. Terminate conductors on a terminal strip.
3. Insulate selected types of wire splices and/or install a motor connection kit.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Heat-shrink insulators
Transparencies	Heat gun for shrink insulators
Blank acetate sheets	Assorted sizes and types of wire nuts
Transparency pens	Hand crimping tools and dies
Whiteboard/chalkboard	Hydraulic crimping tools and dies
Markers/chalk	Metal-clad cable
Pencils and scratch paper	Type MC cable connectors
Prism	Ratchet cable bender
Copy of the latest edition of the <i>National Electrical Code</i> [®]	Heat-shrink and roll-on insulating tapes
Wire strippers	Propane torch
Power cable strippers	Torque wrenches
Assorted sizes of wire/cables and connectors	Multimeter
Assorted sizes and types of crimp connectors	Test circuit
Assorted sizes and types of mechanical compression connectors	Quick Quiz*
	Module Examinations**
	Performance Profile Sheet**

* Located in the back of this module.

** Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to terminate cable. Make sure that all trainees are briefed on appropriate safety procedures. Emphasize electrical safety. This module may require that trainees visit job sites. Ensure all trainees are properly briefed on site safety.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference work is suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 7½ hours are suggested to cover *Conductor Terminations and Splices*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction, Stripping, and Insulation	
A. Introduction	_____
B. Stripping and Cleaning Conductors	_____
C. Wire Connections Under 600V	_____
D. Laboratory Trainees practice installing heat-shrink insulators. This laboratory corresponds to Performance Task 3.	_____
Session II. Terminating Cable	
A. Control and Signal Cable	_____
B. Low-Voltage Connectors and Terminal	_____
C. Guidelines for Installing Connectors	_____
D. Laboratory Trainees practice terminating conductors. This laboratory corresponds to Performance Tasks 1 and 2.	_____
E. Bending Cable and Training Conductors	_____
F. NEC® Termination Requirements	_____
Session III. Additional Topics, Review, and Testing	
A. Taping Electrical Joints	_____
B. Motor Connection Kits	_____
C. Laboratory Trainees practice installing a motor connection kit. This laboratory corresponds to Performance Task 3.	_____
D. Module Review	_____
E. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
F. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module introduces the *NEC*[®] requirements and procedures for proper grounding and bonding.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum*; *Electrical Level One*; and *Electrical Level Two*, Modules 26201-08 through 26208-08.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Explain the purpose of grounding and bonding and the scope of *NEC Article 250*.
2. Distinguish between a short circuit and a ground fault.
3. Define the *National Electrical Code*[®] requirements related to bonding and grounding.
4. Distinguish between grounded systems and equipment grounding.
5. Use *NEC Table 250.66* to size the grounding electrode conductor for various AC systems.
6. Explain the function of the grounding electrode system and determine the grounding electrodes to be used.
7. Define electrodes and explain the resistance requirements for electrodes using *NEC Section 250.56*.
8. Use *NEC Table 250.122* to size the equipment grounding conductor for raceways and equipment.
9. Explain the function of the main and system bonding jumpers in the grounding system and size the main and system bonding jumpers for various applications.
10. Size the main bonding jumper for a service utilizing multiple service disconnecting means.
11. Explain the importance of bonding equipment in clearing ground faults in a system.
12. Explain the purposes of the grounded conductor (neutral) in the operation of overcurrent devices.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Using the proper fittings, connect one end of a No. 4 AWG bare copper grounding wire to a length of $\frac{3}{4}$ " galvanized water pipe and the other end to the correct terminal in a main panelboard.
2. Install two lengths of Type NM cable in a switch box using Type NM cable clamps:
 - Strip the ends of the cable to conform with *National Electrical Code*[®] requirements.
 - Secure the cable in the switch box and tighten the cable clamps.
 - Connect and secure the equipment grounding conductors according to *NEC*[®] requirements, and secure to the switch box with either a ground clip or a grounding screw.
3. Size the minimum required grounding electrode conductor for a 200A service fed by 3/0 copper.
4. Size the minimum required equipment grounding conductor in each conduit for a 400A feeder gap using two parallel runs of 3/0 copper.
5. Size the minimum required bonding jumper for a copper water pipe near a separately derived system (transformer) where the secondary conductors are 500 kcmil copper.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Prism

Copy of the latest edition of the *National Electrical Code*[®]
OSHA Electrical Safety Guidelines (pocket guide)
No. 4 AWG bare copper grounding wire
Small main panelboard
Switch boxes
Grounding clips, screws, and clamps
Galvanized water pipe

Various lengths of Type NM cable
Wire strippers
Earth ground resistance tester

Quick Quiz*
Module Examinations**
Performance Profile Sheet**

*Located in the back of this module.

**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to terminate and install cable. Make sure that all trainees are briefed on appropriate safety procedures. Emphasize electrical safety. This module may require that trainees visit job sites. Ensure that all trainees are properly briefed on site safety.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference work is suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *Grounding and Bonding*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction to Grounding and Bonding	
A. Introduction	_____
B. Purpose of Grounding and Bonding	_____
C. NEC® Requirements for Grounding and Bonding	_____
D. Short Circuit Versus Ground Fault	_____
E. Types of Grounding Systems	_____
Session II. Grounding Equipment	
A. NEC® Requirements for Grounding Equipment	_____
B. Laboratory Trainees practice sizing grounding electrode conductors. This laboratory corresponds to Performance Task 3.	_____
C. Equipment Grounding	_____
D. Laboratory Trainees practice sizing equipment grounding conductors. This laboratory corresponds to Performance Tasks 2 and 4.	_____

Session III.

- A. Bonding Service Equipment
- B. Effective Grounding Path
- C. Grounded Conductor
- D. Separately Derived Systems
- E. Laboratory

Trainees practice sizing and installing grounding jumpers. This laboratory corresponds to Performance Tasks 1 and 5.

Session IV.

- A. Grounding at More Than One Building
- B. Systems Over 1,000 Volts
- C. Testing for Effective Grounds
- D. Measuring the Earth's Resistance

Session V. Three-Point Testing

- A. Three-Point Testing Procedure for Single Electrode or Triad
- B. Procedures
- C. Electrode Arrangements
- D. Equipotential Grounding

Session VI. Review and Testing

- A. Module Review
- B. Module Examination
 - 1. Trainees must score 70% or higher to receive recognition from NCCER.
 - 2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
- C. Performance Testing
 - 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
 - 2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

MODULE OVERVIEW

This module introduces the methods and procedures used in the selection and installation of circuit breakers and fuses.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Electrical Level One; and Electrical Level Two*, Modules 26201-08 through 26209-08.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Explain the necessity of overcurrent protection devices in electrical circuits.
2. Define the terms associated with fuses and circuit breakers.
3. Describe the operation of a circuit breaker.
4. Apply the *National Electrical Code*[®] (*NEC*[®]) requirements for overcurrent devices.
5. Describe the operation of single-element and time-delay fuses.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify the following on one or more circuit breaker(s) and fuse(s):
 - Number of poles
 - Load rating
 - Voltage rating
 - Amperage interrupting rating

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Prism
Copy of the latest edition of the *National Electrical Code*[®]
OSHA Electrical Safety Guidelines (pocket guide)
Samples of circuit breakers, including:

- Single-pole
- Two-pole
- Three-pole

Various types of GFCIs
Samples of various types of fuses, including:

- Edison-base fuses
- Type S fuses and adapters
- Nonrenewable cartridge fuses
- Renewable cartridge fuses

Several blown renewable cartridge fuses with renewable links
Quick Quiz*
Module Examinations**
Performance Profile Sheet**

*Located in the back of this module.

**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to work with circuit breakers and fuses. Make sure that all trainees are briefed on appropriate safety procedures. Emphasize electrical safety. This module may require that trainees visit job sites. Ensure that all trainees are properly briefed on site safety.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference work is suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 12.5 hours are suggested to cover *Circuit Breakers and Fuses*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction and Circuit Breaker Ratings	
A. Introduction	_____
B. Circuit Breaker Ratings	_____
Session II. GFCI and Fuses	
A. Ground Fault Current Circuit Protection	_____
B. Fuses	_____
C. Laboratory Trainees practice identifying fuses and circuit breakers. This laboratory corresponds to Performance Task 1.	_____
Session III. Overcurrents and Sizing	
A. Overcurrents	_____
B. Guide to Sizing Fuses	_____
Session IV. Safety and Coordination	
A. Safety	_____
B. Coordination	_____
Session V. Review and Testing	
A. Module Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
C. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module introduces the *NEC*[®] requirements and procedures used in the selection and installation of conductors and relays.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Electrical Level One; and Electrical Level Two*, Modules 26201-08 through 26210-08.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Describe the operating principles of contactors and relays.
2. Select contactors and relays for use in specific electrical systems.
3. Explain how mechanical contactors operate.
4. Explain how solid-state contactors operate.
5. Install contactors and relays according to the *NEC*[®] requirements.
6. Select and install contactors and relays for lighting control.
7. Read wiring diagrams involving contactors and relays.
8. Describe how overload relays operate.
9. Connect a simple control circuit.
10. Test control circuits.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Mount and connect a 120V lighting contactor with a three-wire pushbutton control.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	120V lighting contactors
Transparencies	Pushbutton stations
Blank acetate sheets	Lampholders and lamps
Transparency pens	Cable for connecting contactors
Whiteboard/chalkboard	Electrician's tool set
Markers/chalk	Quick Quiz*
Pencils and scratch paper	Module Examinations**
Prism	Performance Profile Sheet**
Copy of the latest edition of the <i>National Electrical Code</i> [®]	

*Located in the back of this module.

**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code..

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to connect lighting controls. Make sure that all trainees are briefed on appropriate safety procedures. Emphasize electrical safety. This module may require that trainees visit job sites. Stress the importance of following the proper safety precautions and procedures when installing various types of contactors and relays.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference work is suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 12.5 hours are suggested to cover *Control Systems and Fundamental Concepts*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I and II. Introduction and Magnetic Contactors	
A. Introduction	_____
B. Magnetic Contactors	_____
C. Laboratory Trainees practice connecting lighting contactors. This laboratory corresponds to Performance Task 1.	_____
Session III. Relays	
A. Relays	_____
B. Solid-State Relays	_____
C. Guidelines for Installing Connectors	_____
D. Overload Relays	_____
Session IV. Protective Enclosures and Remote Control Switching	
A. Protective Enclosures	_____
B. Low-Voltage Remote Control Switching	_____
Session V. Troubleshooting	
A. Troubleshooting	_____
Session VI. Review and Testing	
A. Module Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
C. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	