

CONTROL SYSTEMS AND FUNDAMENTAL CONCEPTS

Module Eleven (26211-17) describes the operating principles of contactors and relays, including both mechanical and solid-state devices. It also explains how to select and install relays and troubleshoot control circuits.

Objectives

Learning Objective 1

- Identify magnetic and mechanically held contactors.
 - a. Select lighting contactors.
 - b. Make forward and reverse motor contactor connections.
 - c. Select mechanically held contactors.

Learning Objective 2

- Select and troubleshoot relays.
 - a. Select control relays.
 - b. Select timers and timing relays.
 - c. Select solid-state relays.
 - d. Select overload relays.
 - e. Troubleshoot relays.

Learning Objective 3

- Install low-voltage remote control switching systems.
 - a. Identify remote control switching system components and operating characteristics.
 - b. Plan and install a remote control switching system.

Performance Task

Performance Task 1 (Learning Objective 3)

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

Note

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Teaching Time: 12.5 hours

(Five 2.5-Hour Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint[®] presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the PowerPoint[®] presentations and Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the module examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the module examination; performance testing is graded pass or fail.



Safety Considerations

Emphasize the importance of wearing the proper PPE, following safe practices, and giving due respect to any hazards that may be present while working with or in the vicinity of electrical wiring. Trainees must clearly understand these considerations to ensure their safety in the future. Remind trainees that the safety procedures on a particular job site may be more stringent than OSHA or *NEC*[®] requirements.

Classroom Equipment and Materials

Whiteboard and markers	Lighting contactors	Low-voltage relays
Pencils and paper	Relays	Transformers
<i>Electrical Level Two</i> PowerPoint [®]	Control relays	Low-voltage switches
Presentation Slides	Timers and timing relays	Master sequencer(s)
DVD player	Solid-state relays	Drawings and schematics of low-voltage remote control switching systems
LCD projector and screen	Thermal overload relays	Module Review answer key
Computer	Magnetic overload relays	Module Examinations
Internet access during class (optional)	Pneumatic timers	Performance Profile Sheets
Magnetic contactors	Components of a low-voltage remote control switching system including:	
Mechanically held contactors		

Equipment and Materials for Laboratories and Performance Testing

Standard eye protection	Hard hat	Hearing protection as designated by the instructor or training facility provider
Work gloves	Proper footwear as designated by the instructor or training facility provider	

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Lessons in Electric Circuits, Volume IV (free online textbook). www.allaboutcircuits.com

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

There are a number of online resources available for trainees who would like more information on control systems. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Instructors are also encouraged to locate additional audiovisual aids available on the internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint[®] presentations throughout the program.

CONTROL SYSTEMS AND FUNDAMENTAL CONCEPTS

The Lesson Plan for this module is divided into five 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

SESSION ONE

Session One covers Sections 1.0.0 through 1.3.0 and identifies magnetic and mechanically held contactors.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with contactors.
3. Describe how to select lighting contactors.
4. Explain how to make forward and reverse motor contactor connections.
5. Describe how to select mechanically held contactors.

SESSION TWO

Session Two covers Sections 2.0.0 through 2.5.0 and explains how to select and troubleshoot relays.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with different types of relays.
3. Explain how to select control relays.
4. Explain how to select timers and timer relays.
5. Explain how to select solid-state relays.
6. Explain how to select overload relays.
7. Describe how to troubleshoot relays.

SESSION THREE

Session Three covers Sections 3.0.0 through 3.2.2 and describes how to install low-voltage remote control switching systems.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with low-voltage remote control switching systems.
3. Explain how to identify remote control switching system components and operating characteristics.
4. Describe how to plan and install a remote control switching system.

SESSION FOUR

This session is set aside for lab work needed to satisfy Performance Task 1. Note that there is no PowerPoint® presentation associated with this session. The lab includes the following activities:

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

You can allocate lab time for these activities based on class size and available facilities. One approach would be to have multiple workstations to enable more than one trainee to complete the task at the same time.

Upon completion of the lab work, ask the trainees to complete the module Review Questions and Supplemental Exercises prior to the upcoming review and testing session.



CONTROL SYSTEMS AND FUNDAMENTAL CONCEPTS

SESSION FIVE

Session Five is a review and testing session. Go over the module Review Questions and Supplemental Exercises in class prior to the exam and answer any questions that the trainees may have.

1. Administer the Module Examination and any outstanding performance testing.
2. Submit the results to your Training Program Sponsor through the Registry System.



ADVANCED CONTROLS

Module Seven (26407-17) discusses applications and operating principles of solid-state controls, reduced-voltage starters, and adjustable-frequency drives. It also covers basic troubleshooting procedures.

Objectives

Learning Objective 1

- Describe the various types of relays used in motor control circuits.
 - a. Identify and describe solid-state relays and their uses.
 - b. Identify and describe programmable and nonprogrammable solid-state protective relays and their uses.
 - c. Identify and describe timing relays and their uses.

Learning Objective 2

- Explain how reduced-voltage starting is accomplished.
 - a. Describe the use and selection of conventional reduced-voltage motor starting methods.
 - b. Describe solid-state reduced-voltage motor starting methods.
 - c. Describe the precautions associated with solid-state controls.
 - d. Describe the preventive maintenance procedures associated with solid-state controls.

Learning Objective 3

- Describe the types and uses of adjustable-frequency drives.
 - a. Describe the operation and types of adjustable-frequency drives.
 - b. Identify the selection considerations for adjustable-frequency drives.

Learning Objective 4

- Describe motor braking methods.
 - a. Describe dynamic braking methods.
 - b. Describe friction braking.

Learning Objective 5

- Describe how to troubleshoot motor controls.
 - a. Explain basic troubleshooting methods.
 - b. Describe the electrical troubleshooting methods used to check control circuits and devices.

Performance Tasks

Performance Task 1 (Learning Objectives 1 and 2)

- Identify and connect various control devices.

Note

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Teaching Time: 20 hours

(Eight 2.5-Hour Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint[®] presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the PowerPoint[®] presentations and Performance Profile Sheets from **www.nccerirc.com**. For information and updates about accessing the module examinations, visit **www.nccer.org/testing**. The passing score for submission into NCCER's Registry is 70% or above for the module examination; performance testing is graded pass or fail.



Safety Considerations

Remind the trainees to wear safety glasses and gloves when handling components and to follow all applicable safety precautions when using meters.

Classroom Equipment and Materials

Whiteboard and markers	Selected controls for connection into a three-phase motor circuit	Good and faulty contacts
Pencils and paper	Heat sinks	Multimeter
<i>Electrical Level Four PowerPoint®</i> Presentation	Nonprogrammable solid-state overload relays (SSOLRs)	Three-phase circuit with load
DVD player	Programmable SSOLRs	Manufacturer's troubleshooting charts for one or more motors
LCD projector and screen	Timing relays	Module Review answer key
Computer	Pneumatic timing relay	Module Examinations
Internet access during class (optional)	Dashpot timing relay	Copies of the Performance Profile Sheets
Standard eye protection and work gloves for handling components	Solid-state plug-in timing relays	

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Motor Control Technology for Industrial Maintenance, Thomas E. Kissell. New York, NY: Pearson Education, Inc.

There are a number of online resources available for trainees who would like more information on advanced controls. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Instructors are also encouraged to locate additional audiovisual aids available on the Internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.

ADVANCED CONTROLS

The Lesson Plan for this module is divided into eight 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

SESSION ONE

Session One covers Sections 1.0.0 through 1.3.4. It describes various types of relays.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the operation of relays.
3. Identify and describe solid-state relays and their uses.
4. Identify and describe programmable and nonprogrammable solid-state protective relays and their uses.
5. Identify and describe timing relays and their uses.

SESSION TWO

Session Two covers Sections 2.0.0 through 2.4.0. It describes reduced-voltage starting methods.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with reduced-voltage starting methods.
3. Describe the use and selection of conventional reduced-voltage motor starting methods.
4. Describe solid-state reduced-voltage motor starting methods.
5. Describe the precautions associated with solid-state controls.
6. Describe the preventive maintenance procedures associated with solid-state controls.

SESSION THREE

Session Three covers Sections 3.0.0 through 3.2.5. It describes adjustable-frequency drives.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with adjustable-frequency drives.
3. Describe the operation and types of adjustable-frequency drives.
4. Identify the selection considerations for adjustable-frequency drives.

SESSION FOUR

Session Four covers Sections 4.0.0 through 4.2.0. It describes motor braking methods.

1. Show the Session Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with motor braking methods.
3. Describe dynamic braking methods.
4. Describe friction braking.



ADVANCED CONTROLS

SESSION FIVE

Session Five covers Sections 5.0.0 through 5.2.8. It describes how to troubleshoot motor controls.

1. Show the Session Five PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with motor control troubleshooting.
3. Explain basic troubleshooting methods.
4. Describe the electrical troubleshooting methods used to check control circuits and devices.

SESSION EIGHT

Session Eight is a review and testing session. Note that there is no PowerPoint® presentation associated with this session. Go over the Module Review questions and Supplemental Exercises in class before the exam and answer any questions that the trainees may have.

1. Administer the Module Examination and any outstanding performance testing.
2. Submit the results to your Training Program Sponsor through the Registry System.

SESSIONS SIX & SEVEN

Sessions Six and Seven are laboratory sessions. Note that there is no PowerPoint® presentation associated with these sessions.

1. Demonstrate how to connect various control devices.
2. Have the trainees identify and connect various control devices. This activity corresponds to Performance Task 1.
3. Document successful Performance Task completions for each trainee on the Performance Profile Sheet and submit the results to the Training Program Sponsor.



BASIC ELECTRONIC THEORY

Module Four (26404-17) explains the function and operation of basic electronic devices, including semiconductors, diodes, rectifiers, and transistors.

Objectives

Learning Objective 1

- Describe electronic fundamentals.
 - a. Explain basic electronic theory.
 - b. Explain semiconductor fundamentals.

Learning Objective 2

- Identify and describe semiconductor devices.
 - a. Describe the operation and uses of diodes.
 - b. Describe the operation and uses of transistors.
 - c. Describe the operation and uses of semiconductor switching devices.

Performance Tasks

Performance Task 1 (Learning Objective 2)

- Test a transistor to determine whether it is an NPN or PNP.

Performance Task 2 (Learning Objective 2)

- Identify the cathode on three different styles of SCRs, using the shape or markings for identification.

Note

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Teaching Time: 10 hours

(Four 2.5-Hour Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint[®] presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the PowerPoint[®] presentations and Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the module examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the module examination; performance testing is graded pass or fail.

Safety Considerations

Remind the trainees to wear safety glasses and gloves when handling components and to follow all applicable safety precautions when using meters.

Classroom Equipment and Materials

Whiteboard and markers	Examples of conductors and insulators	Multimeters
Pencils and paper	Standard eye protection and work gloves for handling components	Module Review answer key
<i>Electrical Level Four</i> PowerPoint® Presentation	Various diodes, including light-emitting diodes (LEDs)	Module Examinations
DVD player	Transistors	Copies of the Performance Profile sheets
LCD projector and screen	Silicon-controlled rectifiers (SCRs)	
Computer		
Internet access during class (optional)		

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

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

Electronics, 2nd Edition. Allen R. Hambley. New York, NY: Pearson Education, Inc. (2000).

There are a number of online resources available for trainees who would like more information on electronic theory. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Instructors are also encouraged to locate additional audiovisual aids available on the Internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.

Session Outline for Module 26404-17

BASIC ELECTRONIC THEORY

The Lesson Plan for this module is divided into four 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

SESSION ONE

Session One covers Sections 1.0.0 through 1.2.3 and discusses electronic fundamentals.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with basic electronic theory.
3. Describe the principles of basic electronics.
4. Describe the operation of semiconductors.

SESSION TWO

Session Two covers Sections 2.0.0 through 2.3.3. It describes how to identify semiconductor devices.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with diode identification.
3. Describe the operation and use of diodes.
4. Describe the operation and use of transistors.
5. Describe the operation and use of semiconductor switching devices.

SESSION THREE

This session is set aside for lab work needed to satisfy Performance Tasks 1 and 2. Note that there is no PowerPoint® presentation associated with this session.

1. Demonstrate how to test a transistor to determine whether it is an NPN or PNP.
2. Demonstrate how to identify the cathode on three different styles of SCRs, using the shape or markings for identification.
3. Have each trainee demonstrate how to identify NPN and PNP transistors and identify the cathode end of one or more SCRs. These activities correspond to Performance Task 2.
4. Document successful Performance Task completions for each trainee on the Performance Profile Sheet and submit the results to the Training Program Sponsor.

Upon completion of the lab work, ask the trainees to complete the Module Review questions and Supplemental Exercises before the upcoming review and testing session.

SESSION FOUR

Session Four is a review and testing session. Go over the Module Review questions and Supplemental Exercises in class before the exam and answer any questions that the trainees may have.

Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.



FIRE ALARM SYSTEMS

Module Five (26405-17) covers the technologies, codes, and wiring approaches used to assemble a fire alarm system. Installation and troubleshooting techniques are also explained.

Objectives

Learning Objective 1

- Describe the various codes and standards that relate to fire alarm systems.
 - a. Explain how codes and standards are implemented and list organizations responsible for their creation and maintenance.
 - b. List the various NFPA codes and standards that apply to fire alarm systems.

Learning Objective 2

- Describe the basic types of fire alarm systems and their primary components.
 - a. Describe the basic types of fire alarm communication systems.
 - b. Describe the primary components of fire alarm systems.

Learning Objective 3

- Describe fire alarm control panels and their primary features.
 - a. Describe fire alarm control panels and their power source requirements.
 - b. Explain how users interface with the control panel.
 - c. Define and describe initiating circuits and panel outputs.

Learning Objective 4

- Identify and describe approaches to fire alarm notification and communication/monitoring.
 - a. Describe visual and audible notification devices and systems.
 - b. Describe important considerations in the use of fire alarm notification signals.
 - c. Describe communication and monitoring options for fire alarm systems.

Learning Objective 5

- Describe fire alarm system installation guidelines and requirements.
 - a. Describe the general wiring requirements.
 - b. Describe the general installation requirements for wiring and various components.
 - c. Describe the installation guidelines for totally protected premises.
 - d. Describe the installation guidelines for fire alarm-related systems and devices.
 - e. Describe how to troubleshoot fire alarm systems.

Performance Task

Performance Task 1 (Learning Objectives 1–5)

- Connect selected fire alarm system(s).

Note

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Teaching Time: 15 hours

(Six 2.5-Hour Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint[®] presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the PowerPoint[®] presentations and Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the module examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the module examination; performance testing is graded pass or fail.



Safety Considerations

This module covers material that involves working with and around fire alarm systems and equipment used in various facilities. Safety must be emphasized at all times. When working in an electrical environment, instructors must ensure that trainees wear the proper PPE, follow safe practices, and give due respect to unseen hazards related to electrical circuits and equipment. Any deficiencies must be corrected to ensure the future safety of all trainees. Practice sessions and Performance Tasks must be completed under your direct supervision.

Classroom Equipment and Materials

Whiteboard and markers

Pencils and paper

Electrical Level Four PowerPoint® Presentation Slides

DVD player

LCD projector and screen

Computer

Internet access during class (optional)

Samples of the following devices:

Various automatic and fixed-temperature heat detectors

Rate-of-rise with fusible link heat detectors

Rate-of-rise with bimetallic heat detectors

Ionization detectors

Photoelectric detectors

Duct detectors

Cloud chamber smoke detectors

Restorable semiconductor line-type heat detectors

Non-restorable fusible line-type heat detectors

Selected detectors for completion of the Performance Task

Access to a circuit setup to connect a selected fire alarm system

Copies of the *National Electrical Code*® Handbook, Current Edition

Access to Certified Alarm Technician Level 1

Access to Practical Fire Alarm Course

Access to Understanding Alarm Systems

Module Review answer key

Module Examinations

Copies of Performance Profile Sheets

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

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

Certified Alarm Technician Level 1, Electronic Security Association. Available at www.esaweb.org/nts.

Practical Fire Alarm Course, Electronic Security Association. Available at www.esaweb.org/nts.

Understanding Alarm Systems, Electronic Security Association. Available at www.esaweb.org/nts.

There are a number of online resources available for trainees who would like more information on fire alarm systems. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Instructors are also encouraged to locate additional audiovisual aids available on the internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.

Session Outline for Module 26405-17

FIRE ALARM SYSTEMS

The Lesson Plan for this module is divided into six 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

SESSION ONE

Session One covers Sections 1.0.0 through 2.1.3. It covers various codes and standards that relate to fire alarm systems, and describes basic types of fire alarm systems.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with different types of fire alarm equipment and systems, as well as the codes and standards that apply to those systems.
3. Explain how codes and standards are implemented and list organizations responsible for their creation and maintenance.
4. List the various NFPA codes and standards that apply to fire alarm systems.
5. Describe the basic types of fire alarm systems.

SESSION TWO

Session Two covers Sections 2.2.0 through 2.2.8 and examines the primary components of fire alarm systems.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with different types of flame, heat, and smoke sensing devices that can be integrated into a fire alarm system to provide detection, warning, and alerting in the event of a fire.
3. Describe the primary components of fire alarm systems.

SESSION THREE

Session Three covers Sections 3.0.0 through 4.3.3 and describes fire alarm control panels and their primary features. It also identifies and describes approaches to fire alarm notification and communication/monitoring.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the capabilities of fire alarm control panels.
3. Describe fire alarm control panels and their power source requirements.
4. Explain how users interface with the control panel.
5. Define and describe initiating circuits and panel outputs.
6. Describe visual and audible notification devices and systems.
7. Describe important considerations in the use of fire alarm notification signals.
8. Describe communication and monitoring options for fire alarm systems.

SESSION FOUR

Session Four covers Sections 5.0.0 through 5.3.9 and describes fire alarm system installation guidelines and requirements.

1. Show the Session Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the placement of fire detection devices and the wiring of a fire alarm control panel.
3. Describe the general wiring requirements.
4. Describe the general installation requirements for wiring and various components.
5. Describe the installation guidelines for totally protected premises.



FIRE ALARM SYSTEMS

SESSION FIVE

Session Five covers Sections 5.4.0 through 5.5.2 and describes fire alarm-rated systems and troubleshooting. The end of the session is devoted to a laboratory and the completion of Performance Task 1.

1. Show the Session Five PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with troubleshooting problems in a fire alarm system.
3. Describe the installation guidelines for fire alarm-related systems and devices.
4. Describe how to troubleshoot fire alarm systems.
5. Have trainees practice and/or complete the tasks associated with Performance Task 1 to conclude the session.

SESSION SIX

Session Six is a review and testing session. Go over the Module Review questions and Supplemental Exercises in class prior to the exam and answer any questions that the trainees may have.

Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.



STANDBY AND EMERGENCY SYSTEMS

Module Three (26403-17) explains the *NEC*[®] installation requirements for electric generators and storage batteries.

Objectives

Learning Objective 1

- Differentiate between emergency and standby systems and identify their primary components.
 - a. Identify emergency and standby power system components.
 - b. Explain the principles of transfer switch operation and their configuration/sizing considerations.

Learning Objective 2

- Describe battery and UPS system types and explain their maintenance requirements.
 - a. Describe the different types of batteries used.
 - b. Explain the maintenance requirements of batteries and their charging considerations.
 - c. Identify single- and double-conversion UPS systems.

Learning Objective 3

- Describe the *NEC*[®] requirements for emergency/standby power and lighting systems.
 - a. Describe legally required standby systems.
 - b. Describe the alternate power requirements for health care facilities.
 - c. Describe the alternate power requirements for places of assembly.
 - d. Describe emergency lighting requirements and devices for public buildings.

Performance Task

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

Note

NFPA 70[®], *National Electrical Code*[®] and *NEC*[®] are registered trademarks of the National Fire Protection Association, Quincy, MA.

Teaching Time: 10 hours

(Four 2.5-Hour Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint[®] presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the PowerPoint[®] presentations from www.nccerirc.com. For information and updates about accessing the module examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the module examination.



Safety Considerations

This module provides an overview of different types of standby and emergency systems and their operating characteristics. Instructors must ensure that trainees wear the proper PPE, follow safe practices, and give due respect to any hazards that may be present while working with or in the vicinity of generators and storage batteries. Any deficiencies must be corrected to ensure the future safety of all trainees. Point out that the safety procedures on each job site may be more stringent than OSHA or NEC® requirements.

Classroom Equipment and Materials

Whiteboard and markers	Storage batteries	for rinsing eyes and skin in case of contact with electrolyte
Pencils and paper	Battery charger	Acid- or alkali-neutralizing solution
<i>Electrical Level Four</i> PowerPoint® Presentation	Tools to perform resistance and capacity checks on batteries	Insulated tools
DVD player	Chemical-resistant goggles and face shield	Class C fire extinguisher or other type as recommended by the battery manufacturer
LCD projector and screen	Acid-resistant or alkali-resistant gloves	Respirator, if required
Computer	Chemical-resistant protective aprons and overshoes	Module Review answer key
Internet access during class (optional)	Portable or stationary water facilities	Module Examinations
Engine-driven AC generator		
Transfer switches		

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Liquid-Cooled Generator Sets Application Manual, Latest Edition. Minneapolis, MN: Cummins Onan.

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

OT III Transfer Switches Application Manual, Latest Edition. Minneapolis, MN: Cummins Onan.

There are a number of online resources available for trainees who would like more information on standby and emergency systems. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Instructors are also encouraged to locate additional audiovisual aids available on the Internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.

STANDBY AND EMERGENCY SYSTEMS

The Lesson Plan for this module is divided into four 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

SESSION ONE

Session One covers Sections 1.0.0 through 1.2.3 and describes how to identify standby and emergency systems.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with standby and emergency systems.
3. Describe how to identify standby and emergency system components.
4. Describe the operation of transfer switches and explain how they are sized.

SESSION TWO

Session Two covers Sections 2.0.0 through 2.3.2. It describes how to identify and maintain storage batteries and uninterruptible power supply (UPS) systems.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with uninterruptible power supplies.
3. Describe the different types of storage batteries.
4. Identify the maintenance requirements for storage batteries.
5. Identify single- and double-conversion UPS systems.

SESSION THREE

Session Three covers Sections 3.0.0 through 3.4.2 and describes the *NEC*® requirements for emergency systems.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the *NEC*® requirements for various systems.
3. Identify the *NEC*® requirements for legally required standby systems.
4. Describe the alternate power requirements for health care facilities.
5. Describe the alternate power requirements for places of assembly.
6. Describe emergency lighting requirements and devices for public buildings.

SESSION FOUR

Session Four is a review and testing session. Go over the Module Review questions and Supplemental Exercises in class prior to the exam and answer any questions that the trainees may have.

1. Administer the Module Examination.
2. Submit the results to your Training Program Sponsor through the Registry System.



FUNDAMENTALS OF CREW LEADERSHIP

Module 46101-17 teaches skills needed to become an effective crew leader, as well as knowledge and abilities required to transition from craftworker to crew leader. The module also covers workforce diversity and organization, basic leadership skills, safety, and project control.

Objectives

Learning Objective 1

- Describe current issues and organizational structures in industry today.
 - a. Describe the leadership issues facing the construction industry.
 - b. Explain how gender and cultural issues affect the construction industry.
 - c. Explain the organization of construction businesses and the need for policies and procedures.

Learning Objective 2

- Explain how to incorporate leadership skills into work habits, including communications, motivation, team-building, problem-solving, and decision-making skills.
 - a. Describe the role of a leader on a construction crew.
 - b. Explain the importance of written and oral communication skills.
 - c. Describe methods for motivating team members.
 - d. Explain the importance of teamwork to a construction project.
 - e. Identify effective problem-solving and decision-making methods.

Learning Objective 3

- Identify a crew leader's typical safety responsibilities with respect to common safety issues, including awareness of safety regulations and the cost of accidents.
 - a. Explain how a strong safety program can enhance a company's success.
 - b. Explain the purpose of OSHA and describe the role of OSHA in administering worker safety.
 - c. Describe the role of employers in establishing and administering safety programs.
 - d. Explain how crew leaders are involved in administering safety policies and procedures.

Learning Objective 4

- Demonstrate a basic understanding of the planning process, scheduling, and cost and resource control.
 - a. Describe how construction contracts are structured.
 - b. Describe the project planning and scheduling processes.
 - c. Explain how to implement cost controls on a construction project.
 - d. Explain the crew leader's role in controlling project resources and productivity.

Performance Tasks

Performance Task 1 (Learning Objective 4)

- Develop and present a look-ahead schedule.

Performance Task 2 (Learning Objective 4)

- Develop an estimate for a given work activity.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids, including the PowerPoint® presentation, and these lesson plans, and to gather the required equipment and materials. Consider the time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the PowerPoint® presentations and Performance Profile Sheets from www.nccerirc.com. For information about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the module exam; performance testing is graded pass or fail.



Recommended Teaching Time: 22.5 hours

This Lesson Plan (LP) is divided into sections that correspond to the sections in the Trainee Guide module. As you plan your class times, review the objectives, content, and lesson plan outline for the section you plan to teach. Allow sufficient class time for demonstrations, laboratories, field trips, and testing. Each class period should also include time for administrative tasks and periodic breaks.

Be sure to gather the required equipment, materials, visual aids, and answer keys. Using your access code, download the PowerPoint® presentations and Performance Sheets for this module from NCCER's Instructor Resource Center at www.nccerirc.com.

It is advisable to assign the reading of a module section prior to the classroom instruction. The Section Review and Module Review questions may be assigned as homework. At their discretion, instructors may assign additional homework to meet the teaching objectives.

Performance Testing may be administered at any suitable time in the course of the module training. Tasks are graded pass/fail. Trainee performance and proficiency during practice sessions that meets or exceeds the standards for a task can be accepted as Performance Task completion. Complete the Performance Profile Sheet for each trainee.

The final class is generally reserved for a brief review and the written module examination. For information about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the written exam. Record the testing results for each trainee on the Registration of Training Modules form and submit the form to the Training Program Sponsor.

Classroom Equipment and Materials

Whiteboard	LCD projector and screen	Blank copies of takeoff and summary worksheets
Markers	Computer with Internet access during class (optional)	Module Review answer key
Pencils and paper	Blank copies of a look-ahead schedule	Module examinations
<i>Fundamentals of Crew Leadership</i>		Performance Profile Sheets
PowerPoint® Presentation		



Additional Resources

This module presents thorough resources for task training. The following reference material is recommended for further study.

- Construction Workforce Development Professional*, NCCER. 2016. New York, NY: Pearson Education, Inc.
- Mentoring for Craft Professionals*, NCCER. 2016. New York, NY: Pearson Education, Inc.
- Blueprint Reading for Construction*, James A. S. Fatzinger. 2003. New York, NY: Pearson Education, Inc.
- Construction Leadership from A to Z: 26 Words to Lead By*, Wally Adamchik. 2011. Live Oak Book Company.
- Generational Cohorts and their Attitudes Toward Work Related Issues in Central Kentucky*, Frank Fletcher, et al. 2009. Midway College, Midway, KY. www.kentucky.com
- It's Your Ship: Management Techniques from the Best Damn Ship in the Navy*, Captain D. Michael Abrashoff, USN. 2012. New York City, NY: Grand Central Publishing.
- Survival of the Fittest*, Mark Breslin. 2005. McNally International Press.
- The Definitive Book of Body Language: The Hidden Meaning Behind People's Gestures and Expressions*, Barbara Pease and Allan Pease. 2006. New York City, NY: Random House / Bantam Books.
- The Young Person's Guide to Wisdom, Power, and Life Success: Making Smart Choices*, Brian Gahran, PhD. 2014. San Diego, CA: Young Persons Press. www.WPGBlog.com

The following websites offer resources for products and training:

- Aging Workforce News, www.agingworkforcenews.com
- American Society for Training and Development (ASTD), www.astd.org
- Architecture, Engineering, and Construction Industry (AEC), www.aecinfo.com
- Equal Employment Opportunity Commission (EEOC), www.eeoc.gov
- National Association of Women in Construction (NAWIC), www.nawic.org
- National Census of Fatal Occupational Injuries (NCFI), www.bls.gov
- National Institute of Occupational Safety and Health (NIOSH), www.cdc.gov/niosh
- National Safety Council, www.nsc.org
- Occupational Safety and Health Administration (OSHA), www.osha.gov
- Society for Human Resources Management (SHRM), www.shrm.org
- United States Census Bureau, www.census.gov
- United States Department of Labor, www.dol.gov
- US Green Building Council (USGBC), www.usgbc.org/leed
- Wi-Fi® is a registered trademark of the Wi-Fi Alliance, www.wi-fi.org

There are a number of online resources available for trainees who would like more information on effective leadership skills and professionalism in the construction industry. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide examples of both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Instructors are encouraged to locate additional audiovisual aids available on the internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.

