Module One (26101-17) describes the various career paths in the electrical industry. It also covers the apprenticeship requirements for electricians and discusses employer/employee responsibilities.

**Objectives**

**Learning Objective 1**
- Identify the various sectors and trade options in the electrical industry.
  a. Describe the typical components in a residential wiring system.
  b. Describe the typical components in a commercial wiring system.
  c. Describe the typical components in an industrial wiring system.
  d. List various career paths and opportunities in the electrical trade.

**Learning Objective 2**
- Understand the apprenticeship/training process for electricians.
  a. List department of labor (DOL) requirements for apprenticeship.
  b. Describe various types of training in the electrical field.

**Learning Objective 3**
- Understand the responsibilities of the employee and employer.
  a. Identify employee responsibilities.
  b. Identify employer responsibilities.

**Performance Tasks**
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: 2.5 hours**
(One 2.5-Hour Session)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

**Prerequisites**
Core Curriculum

**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 may involve a field trip to a residential, commercial, or industrial installation. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any safety hazards.

Classroom Equipment and Materials
Whiteboard and markers
Pencils and paper
*Electrical Level One* PowerPoint® Presentation Slides
DVD player
LCD projector and screen
Computer
Internet access during class (optional)
Module Review answer key
Module Examinations
NCCER publication *Careers in Construction*

Copies of the help-wanted section from one or more electrical trade publications
Examples of NCCER Training Credentials
Copy of an employee manual from an electrical contractor
Copy of the latest edition of the OSHA Safety and Health Standards for the Construction Industry

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


There are a number of online resources available for trainees who would like more information on pursuing a career as an electrician. 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 26101-17

ORIENTATION TO THE ELECTRICAL TRADE

The lesson plan for this module consists of one 2.5-hour session. This session includes 10 minutes for administrative tasks and one 10-minute break.

SESSION ONE

Session One covers Sections 1.0.0 through 3.0.0, and describes various career paths in the electrical industry, training and apprenticeship, and responsibilities of employers and employees. In addition, this session includes a review of the complete module and the module exam is administered.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to identify the career options for electricians.
3. Identify the various sectors in the electrical industry.
4. Describe the apprenticeship/training process for electricians.
5. Define the responsibilities of the employee and employer.
6. Have the trainees complete the module review questions. Go over the review questions in class prior to the exam and answer any questions that the trainees may have.
7. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Lesson Plans for Module 26102-17

ELECTRICAL SAFETY

Module Two (26102-17) discusses electrical hazards and describes the various types of personal protective equipment (PPE) used to reduce injuries. It also covers the standards related to electrical safety and the OSHA lockout/tagout rule.

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Performance Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Objective 1</td>
<td>Performance Task 1 (Learning Objectives 2 and 4)</td>
</tr>
<tr>
<td>• Identify electrical hazards and their effects.</td>
<td>• Properly select and use PPE.</td>
</tr>
<tr>
<td>a. Understand the effects of electrical shock on the human body.</td>
<td>(Learning Objective 4)</td>
</tr>
<tr>
<td>b. Verify that circuits are de-energized.</td>
<td>• Describe the safety requirements for an instructor-supplied task, such as replacing the lights in your classroom.</td>
</tr>
<tr>
<td>Learning Objective 2</td>
<td>– Discuss the work to be performed and the hazards involved.</td>
</tr>
<tr>
<td>• Use PPE to reduce the risk of injury.</td>
<td>– If a ladder is required, perform a visual inspection on the ladder and set it up properly.</td>
</tr>
<tr>
<td>a. Identify OSHA requirements for protective equipment.</td>
<td>– Ensure that local emergency telephone numbers are either posted or known by you and your partner(s).</td>
</tr>
<tr>
<td>b. Select and use protective equipment.</td>
<td>– Plan an escape route from the location in the event of an accident.</td>
</tr>
<tr>
<td>Learning Objective 3</td>
<td></td>
</tr>
<tr>
<td>• Identify the standards that relate to electrical safety.</td>
<td></td>
</tr>
<tr>
<td>a. Apply OSHA requirements in the workplace.</td>
<td></td>
</tr>
<tr>
<td>b. Understand the purpose of NFPA 70E®.</td>
<td></td>
</tr>
<tr>
<td>Learning Objective 4</td>
<td></td>
</tr>
<tr>
<td>• Recognize the safety requirements for various hazards.</td>
<td></td>
</tr>
<tr>
<td>a. Identify the safety hazards associated with ladders, scaffolds, and lift equipment.</td>
<td></td>
</tr>
<tr>
<td>b. Avoid back injuries by practicing proper lifting techniques.</td>
<td></td>
</tr>
<tr>
<td>c. Demonstrate basic tool safety.</td>
<td></td>
</tr>
<tr>
<td>d. Identify confined space entry procedures.</td>
<td></td>
</tr>
<tr>
<td>e. Work safely with dangerous materials.</td>
<td></td>
</tr>
<tr>
<td>f. Select and use appropriate fall protection.</td>
<td></td>
</tr>
</tbody>
</table>

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.

Prerequisites
Core Curriculum

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 provides an overview of safe working procedures. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any safety hazards. Remind trainees that the safety procedures on each job site may be more stringent than OSHA or NEC® requirements.

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**Classroom Equipment and Materials**

- Whiteboard and markers
- Pencils and paper
- *Electrical Level One* PowerPoint® Presentation Slides
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Copy of the latest edition of the *National Electrical Code®* (pocket guide)
- OSHA Electrical Safety Guidelines (pocket guide)
- *NFPA 70E, Standard for Electrical Safety in the Workplace®*
- Company safety manual
- Solvent MSDS
- Module Review answer key
- Module Examinations
- Performance Profile Sheets

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**Equipment and Materials for Laboratories and Performance Testing**

- Access to eye wash station
- Various types of personal protective and safety equipment, including:
  - Rubber gloves
  - Insulating blankets
  - Hot sticks
  - Fuse pullers
  - Shorting probes
  - Safety glasses/goggles
  - Face shields
- Hard hats
- GFCI device
- Company lockout/tagout procedures
- Lockout/tagout devices and labels
- Work gloves
- Stepladders
- Straight ladders
- Fall arrest system
- Safety harnesses

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**Additional Resources**

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


There are a number of online resources available for trainees who would like more information on electrical safety. 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 26102-17

Electrical Safety

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 3.2.0, and describes procedures for identifying electrical hazards, using appropriate personal protective equipment, and identifying the standards that govern safety in the workplace.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with construction safety.
3. Describe the effects of electrical shock on the human body.
4. Explain how to verify that circuits are de-energized.
5. Identify OSHA requirements for protective equipment.
6. Demonstrate how to select and use protective equipment.
7. Identify the standards that govern safety in the workplace.

**SESSION TWO**

Session Two covers Sections 4.0.0 through 4.3.2, and describes procedures for identifying the safety requirements for working at elevations, lifting, and tool use.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with scaffold hazards.
3. Identify the safety hazards associated with ladders and scaffolds.
4. Identify the safety hazards associated with lifts, hoists, and cranes.
5. Demonstrate how to avoid back injuries by practicing proper lifting techniques.
6. Demonstrate basic tool safety.

**SESSIONS THREE & FOUR**

Sessions Three & Four cover Sections 4.4.0 through 4.6.3, and describe procedures for confined spaces, dangerous materials, and fall protection. In addition, this session includes a review of the complete module and administration of the module exam.

1. Show the Sessions Three & Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with fall hazards.
3. Identify confined space entry procedures.
4. Describe how to work safely with dangerous materials.
5. Demonstrate how to select and use appropriate fall protection.
6. Have the trainees complete the tasks in Performance Tasks 1 and 2.
7. Have the trainees complete the module review questions. Go over the review questions in class prior to the exam and answer any questions that the trainees may have.
8. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Module Three (26103-17) discusses basic atomic theory. It also covers units of electrical measurement and explains how unknown values can be determined using Ohm’s law and the power equation. It also provides an overview of schematic diagrams and describes how to calculate the value of a resistor.

Objectives

Learning Objective 1
- Describe atomic structure as it relates to electricity.
  a. Identify the components of an atom.
  b. Compare the atomic structures of conductors and insulators.
  c. Identify the role of magnetism in electrical devices.
  d. Identify the basic components in a power distribution system.

Learning Objective 2
- Identify electrical units of measurement.
  a. Define current.
  b. Define voltage.
  c. Define resistance.
  d. Use Ohm’s law to solve for unknown circuit values.

Learning Objective 3
- Read schematic diagrams.
  a. Identify the symbol for a resistor and determine its value based on color codes.
  b. Distinguish between series and parallel circuits.
  c. Identify the instruments used to measure circuit values.
  d. Calculate electrical power.

Performance Tasks
This is a knowledge-based module; there are no performance tasks.

Teaching Time: 7.5 hours
(Three 2.5-Hour Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Prerequisites
Core Curriculum

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
There are no safety considerations for this module.

Classroom Equipment and Materials
Whiteboard and markers
Pencils and paper
Electrical Level One PowerPoint® Presentation Slides
DVD player
LCD projector and screen
Computer
Internet access during class (optional)
Sample schematics
Module Review answer key
Module Examinations

Equipment and Materials for Laboratories and Performance Testing
Appropriate personal protective equipment
Basic electrical circuit, including:
  - Battery/power source
  - Wiring
  - Loads
  - Switches
Examples of conductors, insulators, and color-coded resistors
Magnets
Simple electromagnet
Metal sheet
Iron filings
Various types of meters, including:
  - Multimeter
  - Voltmeter
  - Clamp-on ammeter
  - Ohmmeter
  - Continuity tester
  - Voltage tester

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


There are a number of online resources available for trainees who would like more information on Ohm’s law and DC circuits. 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.
The Lesson Plan for this module is divided into three 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

**SESSION ONE**
Session One covers Section 1.0.0, and describes atomic structure as it relates to electricity.
1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with atomic structure.
3. Identify the components of an atom.
4. Compare the atomic structures of conductors and insulators.
5. Identify the role of magnetism in electrical devices.
6. Identify the basic components in a power distribution system.

**SESSION TWO**
Session Two covers Section 2.0.0 and defines electrical units of measurement.
1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with electrical units of measurement.
3. Define current.
4. Define voltage.
5. Define resistance.
6. Use Ohm’s law to solve for unknown circuit values.

**SESSION THREE**
Session Three covers Section 3.0.0 and introduces schematic diagrams. In addition, this session includes a review of the complete module and the module exam is administered.
1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with schematic diagrams.
3. Identify the symbol for a resistor and demonstrate how to determine its value based on color codes.
4. Explain the differences between series and parallel circuits.
5. Identify the instruments used to measure circuit values.
6. Demonstrate how to calculate electrical power.
7. Have the trainees complete the module review questions. Go over the review questions in class prior to the exam, and answer any questions that the trainees may have.
8. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Lesson Plans for Module 26104-17

**ELECTRICAL THEORY**

Module Four (26104-17) explains how to apply Ohm’s law to series, parallel, and series-parallel circuits. It also covers Kirchhoff’s voltage and current laws.

**Objectives**

<table>
<thead>
<tr>
<th>Learning Objective 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Calculate values in resistive circuits.</td>
</tr>
<tr>
<td>a. Identify resistances in series.</td>
</tr>
<tr>
<td>b. Identify resistances in parallel.</td>
</tr>
<tr>
<td>c. Simplify series-parallel circuits.</td>
</tr>
<tr>
<td>d. Apply Ohm’s law to various types of circuits.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning Objective 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Apply Kirchhoff’s laws to various types of circuits.</td>
</tr>
<tr>
<td>a. Use Kirchhoff’s current law.</td>
</tr>
<tr>
<td>b. Use Kirchhoff’s voltage law.</td>
</tr>
</tbody>
</table>

**Performance Tasks**

This is a knowledge-based module; there are no performance tasks.

**Teaching Time: 7.5 hours**

(Three 2.5-Hour Sessions)

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

**Prerequisites**

Core Curriculum

**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
There are no safety considerations for this module.

Classroom Equipment and Materials
- Whiteboard and markers
- Pencils and paper
- Electrical Level One PowerPoint® Presentation Slides
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Sample schematics
- Module Review answer key
- Module Examinations

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


There are a number of online resources available for trainees who would like more information on electrical 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 26104-17**

**ELECTRICAL THEORY**

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

<table>
<thead>
<tr>
<th>SESSION ONE</th>
<th>SESSION THREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session One covers Sections 1.0.0–1.3.1, and discusses resistive circuit calculations.</td>
<td>Session Three covers Section 2.0.0, and explains Kirchhoff’s laws. In addition, this session includes a review of the complete module and administration of the module exam.</td>
</tr>
<tr>
<td>1. Show the Session One PowerPoint® presentation.</td>
<td>1. Show the Session Three PowerPoint® presentation.</td>
</tr>
<tr>
<td>2. Use the Kickoff Activity to encourage trainees to familiarize themselves with resistive circuit calculations.</td>
<td>2. Use the Kickoff Activity to encourage trainees to familiarize themselves with Kirchhoff’s laws.</td>
</tr>
<tr>
<td>3. Explain how to identify resistances in series.</td>
<td>3. Explain how to use Kirchhoff’s current law.</td>
</tr>
<tr>
<td>4. Explain how to identify resistances in parallel.</td>
<td>4. Explain how to use Kirchhoff’s voltage law.</td>
</tr>
<tr>
<td>5. Demonstrate how to simplify series-parallel circuits.</td>
<td>5. Have the trainees complete the module review questions. Go over the review questions in class prior to the exam and answer any questions that the trainees may have.</td>
</tr>
<tr>
<td>6. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.</td>
<td></td>
</tr>
</tbody>
</table>

Session Two covers Sections 1.4.0–1.4.3, and explains how to apply Ohm’s law.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with Ohm’s law.
3. Demonstrate how to apply Ohm’s law to various types of circuits.
Module Five (26105-17) describes the purpose of the NEC® and explains how to use it to find the installation requirements for various electrical devices and wiring methods. It also provides an overview of the National Electrical Manufacturers Association and Nationally Recognized Testing Laboratories.

**Objectives**

**Learning Objective 1**
- Explain the purpose and history of the NEC®.
  a. Trace the history of the NEC®.
  b. Identify the roles of other organizations.

**Learning Objective 2**
- Navigate the NEC®.
  a. Identify the chapters in the NEC®.
  b. Use the NEC® to find specific installation requirements.

**Performance Tasks**

**Performance Task 1 (Learning Objective 2)**
- Use NEC Article 90 to determine the scope of the NEC®. State what is covered by the NEC® and what is not.

**Performance Task 2 (Learning Objective 2)**
- Find the definition of the term feeder in the NEC®.

**Performance Task 3 (Learning Objective 2)**
- Look up the NEC® specifications that you would need to follow if you were installing an outlet near a swimming pool.

**Performance Task 4 (Learning Objective 2)**
- Find the minimum wire bending space required for two No. 1/0 AWG conductors installed in a junction box or cabinet and entering opposite the terminal.

**Note**

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

**Teaching Time: 7.5 hours**
(Three 2.5-Hour Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

**Prerequisites**
*Core Curriculum*

**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.
Additional Resources

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


There are a number of online resources available for trainees who would like more information on navigating the **National Electrical Code®**. 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 26105-17

INTRODUCTION TO THE NATIONAL ELECTRICAL CODE®

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

**SESSION ONE**

Session One covers Section 1.0.0, and describes the purpose and history of the NEC®.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the role of the NFPA.
3. Trace the history of the NEC®.
4. Identify the roles of other organizations.

**SESSIONS TWO & THREE**

Sessions Two & Three cover Section 2.0.0, and describe procedures for navigating the NEC®. In addition, this session includes a review of the complete module and the module exam is administered.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with navigating the National Electrical Code®.
3. Identify the chapters in the NEC®.
4. Show the trainees how to use the NEC® to find specific installation requirements.
5. Have the trainees find the NEC® information listed in Performance Tasks 1 through 4.
6. Have the trainees complete the module review questions. Go over the review questions in class prior to the exam and answer any questions that the trainees may have.
7. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Lesson Plans for Module 26106-17

DEVICE BOXES

Module Six (26106-17) describes the various types of boxes and explains how to calculate the NEC® fill requirements for outlet and junction boxes under 100 cubic inches (1,650 cubic centimeters). It also covers mounting methods.

Objectives

Learning Objective 1
- Size and install outlet boxes.
  a. Identify boxes and their applications.
  b. Size outlet boxes.
  c. Install outlet boxes.

Learning Objective 2
- Size and install pull and junction boxes.
  a. Size pull and junction boxes.
  b. Install pull and junction boxes.

Performance Tasks

Performance Task 1 (Learning Objective 1)
- Identify the appropriate box type and size for a given application.

Performance Task 2 (Learning Objective 2)
- Select the minimum size pull or junction box for the following applications:
  - Conduit entering and exiting for a straight pull.
  - Conduit entering and exiting at an angle.

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.

Prerequisites

Core Curriculum

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.
Additional Resources

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


There are a number of online resources available for trainees who would like more information on sizing and installing boxes. 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.
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 1.1.5, and describes outlet boxes and their applications.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with outlet boxes.
3. Explain how to identify various types of boxes and their applications.

**SESSION TWO**

Session Two covers Sections 1.2.0 through 1.3.2, and covers outlet box sizing and installation.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with installing outlet boxes.
3. Explain how to size outlet boxes.
4. Explain how to install outlet boxes.
5. Have the trainees identify the appropriate box type and size for a given application. This laboratory corresponds to Performance Task 1.

**SESSION THREE**

Session Three covers Sections 2.0.0 through 2.2.0, and describe procedures for pull and junction box sizing and installation.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with pull box sizing.
3. Describe how to size pull and junction boxes.
4. Describe how to install pull and junction boxes.

**SESSION FOUR**

Session Four is reserved for a laboratory and performance testing.

1. Demonstrate how to install pull and junction boxes.
2. Have the trainees select the minimum size pull or junction box for the following applications (this laboratory corresponds to Performance Task 2):
   - Conduit entering and exiting for a straight pull.
   - Conduit entering and exiting at an angle.
3. Have the trainees complete the module review questions. Go over the review questions in class prior to the exam and answer any questions that the trainees may have.
4. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Module Seven (26107-17) describes methods for hand bending conduit. It covers 90-degree bends, back-to-back bends, offsets, and saddle bends. It also describes how to cut, ream, and thread conduit.

**Objectives**

**Learning Objective 1**
- Select and use hand bending equipment.
  - Use geometry to make a bend.
  - Make 90° bends.
  - Make offset bends.

**Learning Objective 2**
- Cut, ream, and thread conduit.
  - Cut conduit using a hacksaw.
  - Cut conduit using a pipe cutter.
  - Ream conduit.
  - Thread conduit.
  - Cut and join PVC conduit.

**Performance Tasks**

**Performance Task 1 (Learning Objective 1)**
- Make 90° bends, back-to-back bends, offsets, and saddle bends using a hand bender.

**Performance Task 2 (Learning Objective 2)**
- Cut, ream, and thread conduit.

**Note**

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**Teaching Time: 10 hours**

(Each 2.5-Hour Sessions)

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

**Prerequisites**

Core Curriculum

**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 requires trainees to work with conduit bending, cutting, and threading equipment. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any safety hazards. Remind trainees that cut conduit has very sharp edges and gloves must be worn at all times. In addition, safety goggles must be worn to protect against hazardous metal debris.

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**Classroom Equipment and Materials**

- Whiteboard and markers
- Pencils and paper
- *Electrical Level One PowerPoint® Presentation Slides*
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Copy of the latest edition of the

**Equipment and Materials for Laboratories and Performance Testing**

- Safety glasses/goggles
- Hard hats
- Work gloves
- Hand bender and manufacturer’s instructions
- Various pieces of conduit
- Hickey bar
- Manufacturers’ gain tables
- PVC heating unit and plug set
- Tape measure
- Calculator
- Pipe vise
- Pipe cutter
- Reamer
- Cutting oil
- Shop towels
- Hand-operated threader
- Sandbox or drip pan
- Torpedo level
- PVC conduit and fittings
- PVC cements
- Hacksaw

**Additional Resources**

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


There are a number of online resources available for trainees who would like more information on hand bending. 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 26107-17

HAND BENDING

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 1.2.2, and describes procedures for selecting and using hand bending equipment.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with hand bending.
3. Explain how to use geometry to make a bend.
4. Demonstrate how to make 90° and back-to-back bends using a hand bender.
5. Have the trainees practice making 90° and back-to-back bends using a hand bender. This laboratory corresponds to Performance Task 1.

**SESSION TWO**

Session Two covers Sections 1.3.0 through 1.3.3, and describes procedures for making offset bends.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with offset bends.
3. Demonstrate how to make parallel offset bends.
4. Demonstrate how to make various saddle bends.
5. Have the trainees practice making offset and saddle bends using a hand bender. This laboratory corresponds to Performance Task 1.

**SESSION THREE**

Session Three covers Sections 2.0.0 through 2.5.0, and describe procedures for cutting, reaming, and threading conduit.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with cutting, threading, and reaming conduit.
3. Describe how to cut conduit using a hacksaw.
4. Describe how to cut conduit using a pipe cutter.
5. Explain how to ream conduit.
6. Describe how to thread conduit.
7. Explain how to cut and join PVC conduit.

**SESSION FOUR**

Session Four is reserved for a laboratory and performance testing.

1. Demonstrate how to cut, ream, and thread conduit.
2. Have the trainees practice cutting, reaming, and threading conduit. This laboratory corresponds to Performance Task 2.
3. Have the trainees complete the module review questions. Go over the review questions in class prior to the exam and answer any questions that the trainees may have.
4. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Lesson Plans for Module 26108-17

**RACEWAYS AND FITTINGS**

**Module Eight (26108-17)** describes various types of raceway systems, along with their installation and NEC® requirements. It also describes the use of various conduit bodies.

### Objectives

**Learning Objective 1**
- Select and install raceway systems.
  a. Identify types of conduit and their applications.
  b. Properly bond conduit for use as a ground path.
  c. Install metal conduit fittings.
  d. Make conduit-to-box connections.
  e. Identify raceway supports.
  f. Identify installation requirements for various construction methods.

**Learning Objective 2**
- Select fasteners and anchors for the installation of raceway systems.
  a. Select and install tie wraps.
  b. Select and install screws.
  c. Select and install hammer-driven pins and studs.
  d. Identify the safety requirements for stud-type guns.
  e. Select and install masonry anchors.
  f. Select and install hollow-wall anchors.
  g. Select and install epoxy anchoring systems.

**Learning Objective 3**
- Select and install wireways and other specialty raceways.
  a. Identify types of wireways and their components.
  b. Install wireway supports.
  c. Identify and install specialty raceways.

**Learning Objective 4**
- Select and install cable trays.
  a. Identify cable tray types and fittings.
  b. Install cable tray supports.

**Learning Objective 5**
- Handle and store raceways.
  a. Handle raceways.
  b. Store raceways.

### Performance Tasks

**Performance Task 1 (Learning Objective 1)**
- Identify the appropriate conduit body for a given application.

**Performance Task 2 (Learning Objective 2)**
- Identify and select various types and sizes of raceways, fittings, and fasteners for a given application.

**Performance Task 3 (Learning Objective 2)**
- Demonstrate how to install a raceway system.

**Performance Task 4 (Learning Objective 2)**
- Terminate a selected raceway system.

### 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.

### Prerequisites
Core Curriculum
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 requires trainees to work with conduit and fasteners with sharp edges. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any safety hazards.

Classroom Equipment and Materials
- Whiteboard and markers
- Pencils and paper
- Electrical Level One PowerPoint® Presentation Slides
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)

Equipment and Materials for Laboratories and Performance Testing
- Beam clamps
- Concrete, masonry, and wood for fastener application
- Assorted hand tools (wrenches, screwdrivers, hammers)
- Drills/drivers and assorted drill bits
- Hammer-driven tools with related pin and stud fasteners
- Powder-actuated tool, powder charges, and related pin and stud fasteners
- Assorted threaded fasteners, including:
  - Bolts
  - Cap screws
  - studs
  - Machine screws
  - Nuts
  - Washers
  - Special threaded fasteners
  - Tie wraps
- Assorted screws, including:
  - Wood screws
  - Lag screws and shields
  - Concrete/masonry screws
  - Thread-forming (sheet metal) and thread-cutting screws
  - Deck screws
  - Drywall screws
Equipment and Materials for Laboratories and Performance Testing (Continued)

Assorted mechanical anchors and assorted anchor fastening tools, including:
- Wedge
- Stud
- Sleeve
- One-piece
- Hammer-driven
- Drop-in
- Expansion shields
- Screw (fiber, lead, plastic)
- Self-drilling
- Toggle bolts
- Sleeve-type
- Wallboard
- Metal drive-in
- Metal boxes
- Nonmetallic boxes
- Bushings and locknuts

Access to job site where trainees can observe a variety of wireway components, including:
- Connectors
- End plates
- Closing plates
- Tee fittings
- Crosses
- Elbows
- Nipples
- Slip fittings

Access to job site where trainees can observe a variety of cable tray support systems, including:
- Direct rod
- Trapeze mounting
- Center hung support
- Wall mounting
- Pipe rack mounting

Additional Resources

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


There are a number of online resources available for trainees who would like more information on installing raceways and fittings. 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 26108-17
RACEWAYS AND FITTINGS

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 1.0.0–1.1.10, and describes various types of conduit and their applications.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with types of conduit.
3. Identify various types of conduit and their applications.

**SESSIONS TWO AND THREE**

Sessions Two and Three cover Sections 1.2.0–1.6.4, and describe procedures for bonding conduit and selecting metal conduit fittings.

1. Show the Session Two and Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with metal conduit fittings.
3. Demonstrate how to bond conduit for use as a ground path.
4. Demonstrate how to install metal conduit fittings.
5. Demonstrate how to make conduit-to-box connections.
6. Identify various types of raceway supports and describe how they are installed.
7. Identify the installation requirements for various construction methods.
8. Have the trainees identify the appropriate conduit body for a given application. This laboratory corresponds to Performance Task 1.

**SESSIONS FOUR THROUGH SIX**

Sessions Four through Six cover Section 2.0.0, and describe procedures for selecting fasteners and anchors.

1. Show the Sessions Four through Six PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the fasteners and anchors used in raceway systems.
3. Demonstrate how to select and install various fasteners, including tie wraps, screws, and hammer-driven pins and studs.
4. Identify the safety requirements for stud-type guns.
5. Demonstrate how to select and install various anchors, including masonry anchors, hollow-wall anchors, and epoxy anchoring systems.
6. Demonstrate how to install and terminate a raceway system.
7. Have the trainees complete the following tasks:
   - Identify and select various types and sizes of raceways, fittings, and fasteners for a given application.
   - Demonstrate how to install a raceway system.
   - Terminate a selected raceway system.
This laboratory corresponds to Performance Tasks 2 through 4.
### Session Seven

Session Seven covers Section 3.0.0, and describes procedures for selecting and installing wireways and other specialty raceways.

1. Show the Session Seven PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with wireways and raceways.
3. Identify various types of wireways and their components.
4. Explain how to install wireway supports.
5. Identify types of specialty raceways and describe how they are installed.

### Session Eight

Session Eight covers Sections 4.0.0 and 5.0.0, and describes procedures for selecting and installing cable trays. In addition, this session includes a review of the complete module and administering the module exam.

1. Show the Session Eight PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with cable tray systems.
3. Provide an overview of various cable tray types and fittings.
4. Explain how to install cable tray supports.
5. Demonstrate how to connect, bond, and support a cable tray system.
6. Discuss the proper storage and handling of raceways.
7. Have the trainees complete the module review questions. Go over the review questions in class prior to the exam and answer any questions that the trainees may have.
8. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Module Nine (26109-17) discusses conductor types, cable markings, color codes, and ampacity derating. It also describes how to install conductors using fish tape and power conduit fishing systems.

### Objectives

**Learning Objective 1**
- Classify conductors by wire size, insulation, and application.
  - Identify wire sizes.
  - Determine conductor ampacities.
  - Identify conductor materials.
  - Identify conductor insulation.
  - Identify fixture wiring.
  - Identify cable types and applications.
  - Identify instrumentation control wiring.

**Learning Objective 2**
- Install conductors in a conduit system.
  - Install conductors using fish tape.
  - Install conductors using pulling equipment.

### Performance Task

**Performance Task 1 (Learning Objective 2)**
- Install conductors in a raceway system.

### Teaching Time: 10 hours
(Four 2.5-Hour Sessions)

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

### Prerequisites

*Core Curriculum*

### 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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://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 requires trainees to work with conductors and pulling equipment. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any safety hazards. Remind trainees that cut conductors have sharp edges and gloves/safety goggles must be worn at all times. Emphasize the safety hazards and precautions required when pulling conductors.

Classroom Equipment and Materials
- Whiteboard and markers
- Pencils and paper
- *Electrical Level One PowerPoint® Presentation Slides*
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Copy of the latest edition of the *National Electrical Code®*
- Module Review answer key
- Module Examinations
- Performance Profile Sheets

Equipment and Materials for Laboratories and Performance Testing
- Safety glasses/goggles
- Hard hats
- Work gloves
- Electrician's hand tools
- Variety of solid wire conductors
- Samples of stranded conductors
- Fixture wire
- Instrumentation control wire
- Samples of cable, including:
  - Type NM
  - Type NMC
  - Type NMS
  - Type UF
  - Type MV
  - Type MC
  - Type FC
  - Type FCC
  - Type TC
  - Type SE
  - Type USE
  - High-voltage shielded
  - Type FC
  - Type FCC
  - Type TC
  - Type SE
  - Type USE
- Fish tape
- Rodder
- Pull lines
- Basket grip
- Wire grip
- Power fishing system
- Reel cart
- Manual wire puller
- Power puller

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


There are a number of online resources available for trainees who would like more information on installing conductors. 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 26109-17

CONDUCTORS AND CABLES

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 1.4.5, and describes procedures for classifying conductors.
1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with conductor markings.
3. Explain how to identify wire sizes.
4. Explain how to determine conductor ampacities.
5. Explain how to identify conductor materials.
6. Explain how to identify conductor insulation.

SESSION TWO
Session Two covers Sections 1.5.0 through 1.7.3, and describes specialty conductors.
1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with various types of wires and cables.
3. Explain how to identify fixture wiring.
4. Explain how to determine cable types and applications.
5. Explain how to identify instrumentation control wiring.

SESSION THREE
Session Three covers Sections 2.0.0 through 2.2.3, and describes procedures for installing conductors in a conduit system.
1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with fish tape.
3. Describe how to install conductors using fish tape.
4. Describe how to install conductors using pulling equipment.

SESSION FOUR
Session Four is reserved for a laboratory and performance testing.
1. Demonstrate how to install conductors in a raceway system.
2. Have the trainees practice installing conductors in a raceway system. This laboratory corresponds to Performance Task 1.
3. Have the trainees complete the module review questions. Go over the review questions in class prior to the exam and answer any questions that the trainees may have.
4. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Lesson Plans for Module 26110-17

BASIC ELECTRICAL CONSTRUCTION DRAWINGS

Module Ten (26110-17) describes how to interpret electrical drawings, including lighting plans, power riser diagrams, equipment schedules, and specifications. It also covers the use of architect's and engineer's scales.

**Objectives**

**Learning Objective 1**
- Identify types of construction drawings.
  a. Identify the information found on site plans.
  b. Identify the information found on floor plans.
  c. Identify the information found on elevation drawings.
  d. Identify the information found on sectional views.
  e. Identify the information found on title blocks.
  f. Interpret drafting lines.

**Learning Objective 2**
- Work with scale drawings.
  a. Use an architect's scale.
  b. Use an engineer's scale.
  c. Use a metric scale.

**Learning Objective 3**
- Read electrical drawings.
  a. Interpret electrical symbols.
  b. Analyze a set of electrical drawings.
  c. Identify fixtures in a lighting floor plan.
  d. Read block and schematic diagrams.
  e. Interpret written specifications.

**Performance Tasks**

**Performance Task 1 (Learning Objective 2)**
- Using an architect's scale, state the actual dimensions of a given drawing component.

**Performance Task 2 (Learning Objective 3)**
- Make a material takeoff of the lighting fixtures specified in Performance Profile Sheet 2 using the drawing provided on Performance Profile Sheet 3. The takeoff requires that all lighting fixtures be counted, and where applicable, the total number of lamps for each fixture type must be calculated.

**Teaching Time:** 7.5 hours
(Three 2.5-Hour Sessions)

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

**Prerequisites**

Core Curriculum

**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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://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
There are no safety considerations for this module.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- *Electrical Level One* PowerPoint® Presentation Slides
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Copy of the latest edition of the *National Electrical Code®*
- Complete set of construction drawings
- Complete set of electrical drawings, including lighting and panelboard schedules
- Example job specifications
- Module Review answer key
- Module Examinations
- Performance Profile Sheets
- Architect's scales (both flat and triangular)
- Engineer's scale
- Metric scale

Additional Resources

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


There are a number of online resources available for trainees who would like more information on reading construction drawings. 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.
The Lesson Plan for this module is divided into three 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

**SESSION ONE**

Session One covers Section 1.0.0, and describes various types of construction drawings.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with construction drawings.
3. Identify the information found on site plans.
4. Identify the information found on floor plans.
5. Identify the information found on elevation drawings.
6. Identify the information found on sectional views.
7. Identify the information found on title blocks.
8. Interpret drafting lines.

**SESSION TWO**

Session Two covers Section 2.0.0, and describes how to work with scale drawings.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the use of scales.
3. Demonstrate how to use an architect’s scale.
4. Demonstrate how to use an engineer’s scale.
5. Demonstrate how to use a metric scale.
6. Have the trainees use an architect’s scale to find the actual dimensions of a given drawing component. This activity corresponds to Performance Task 1.

**SESSION THREE**

Session Three covers Section 3.0.0, and describes procedures for reading electrical drawings. In addition, this session includes a review of the complete module and administration of the module exam.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with reading electrical drawings.
3. Explain how to interpret electrical symbols.
4. Demonstrate how to analyze a set of electrical drawings.
5. Explain how to identify fixtures in a lighting floor plan.
6. Demonstrate how to read block and schematic diagrams.
7. Explain how to interpret written specifications.
8. Have the trainees make a material takeoff of the lighting fixtures specified in Performance Profile Sheet 2 using the drawing provided on Performance Profile Sheet 3. The takeoff requires that all lighting fixtures be counted, and where applicable, the total number of lamps for each fixture type must be calculated. This activity corresponds to Performance Task 2.
9. Have the trainees complete the module review questions. Go over the review questions in class prior to the exam and answer any questions that the trainees may have.
10. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Module Eleven (26111-17) discusses basic load calculations and NEC® requirements for residential electrical systems. It also describes how to lay out branch circuits, install wiring, size outlet boxes, and install wiring devices.

### Objectives

#### Learning Objective 1
- Size the electric service for a dwelling.
  - Calculate the electric service load.
  - Apply demand factors.
  - Calculate appliance loads.
  - Size the load center.

#### Learning Objective 2
- Identify the grounding requirements for a residential electrical system.
  - Size grounding electrodes.
  - Size the main bonding jumper.
  - Install the equipment grounding system.

#### Learning Objective 3
- Install service-entrance equipment.
  - Identify the service drop location.
  - Select the panelboard location.

#### Learning Objective 4
- Identify wiring methods for various types of residences.
  - Select and install cable systems.
  - Select and install raceways.

#### Learning Objective 5
- Lay out branch circuits and size outlet boxes.
  - Complete the branch circuit layout for power.
  - Complete the branch circuit layout for lighting.
  - Install outlet boxes.

#### Learning Objective 6
- Select and install various wiring devices.
  - Select and install receptacles.
  - Select and install switches.
  - Install devices near residential swimming pools, spas, and hot tubs.

### Performance Tasks

#### Performance Task 1 (Learning Objective 1)
- For a residential dwelling of a given size and equipped with a given list of major appliances, demonstrate or explain how to:
  - Compute lighting, small appliance, and laundry loads.
  - Compute the loads for large appliances.
  - Determine the number of branch circuits required.
  - Size and select the service-entrance conductors, panelboard, and protective devices.

#### Performance Task 2 (Learning Objective 3)
- Using an unlabeled diagram of a panelboard (Performance Profile Sheet 3), label the lettered components.

#### Performance Task 3 (Learning Objective 5)
- Select the proper type and size of outlet box needed for a given set of wiring conditions.

### 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.

### Prerequisites

Core Curriculum
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 requires trainees to work with electrical conductors and boxes with sharp edges. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any safety hazards.

Classroom Equipment and Materials
- Whiteboard and markers
- Pencils and paper
- Electrical Level One PowerPoint® Presentation Slides
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Copy of the latest edition of the National Electrical Code®
- Calculator
- Residential floor plan
- Blank worksheet for general lighting loads
- Module Review answer key
- Module Examinations
- Performance Profile Sheets

Equipment and Materials for Laboratories and Performance Testing
- Appropriate personal protective equipment
- Various types of GFCIs
- Panelboard
- Various grounding devices (clips, screws, clamps, bonding bushings, wedges, etc.)
- Examples of made-type grounding electrodes
- Basic electrician's tools, including various wire cutters and cable strippers
- Examples of cable, including:
  - Type NM
  - Type AC
  - Type UF
  - Type SE/USE
- Examples of raceways, including:
  - Rigid
  - IMC
  - EMT
  - Flexible
  - PVC
- Assortment of metallic and plastic outlet boxes
- Assorted types of electrical receptacles
- Assortment of switches, including:
  - Single-pole
  - Three-way
  - Four-way
  - Photoelectric switches
  - Dimmer
  - Relays

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


There are a number of online resources available for trainees who would like more information on installing residential electrical services. 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.
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.

**SESSIONS ONE AND TWO**

Sessions One & Two cover Section 1.0.0, and they describe procedures for sizing the electrical service for a dwelling.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with residential load estimating.
3. Demonstrate how to calculate the service load for a sample residence.
4. Explain how to apply demand factors.
5. Explain how to calculate appliance loads.
6. Demonstrate how to size the load center, including GFCIs and AFCIs.
7. Have the trainees practice computing lighting, appliance, and laundry loads; determining the number of branch circuits required to serve these loads; and selecting the service-entrance conductors, panelboard, and protective devices. This laboratory corresponds to Performance Task 1.

**SESSION THREE**

Session Three covers Sections 2.0.0 and 3.0.0, and it describes procedures for identifying the grounding requirements for a residential electrical system and installing the service-entrance equipment.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the installation of ground rods.
3. Explain how to size the grounding electrodes for a sample residence.
4. Explain how to size the main bonding jumper for a sample residence.
5. Describe the installation methods for equipment grounding systems.
6. Explain how to identify the service drop location.
7. Describe how to select the panelboard location.
8. Have the trainees label a panelboard diagram. This laboratory corresponds to Performance Task 2.
**SESSION FOUR**

Session Four covers Section 4.0.0, and it describes procedures for identifying wiring methods for various types of residences.

1. Show the Session Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with residential wiring.
3. Demonstrate how to select and install cable systems.
4. Demonstrate how to select and install raceways.

**SESSION FIVE**

Session Five covers Section 5.0.0, and it describes procedures for laying out branch circuits and sizing outlet boxes.

1. Show the Session Five PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with branch circuits and outlet boxes.
3. Explain how to complete the branch circuit layout for power.
4. Explain how to complete the branch circuit layout for lighting.
5. Demonstrate how to select and install outlet boxes.
6. Have the trainees practice selecting the proper type and size of outlet box for a given set of wiring conditions. This laboratory corresponds to Performance Task 3.

**SESSION SIX**

Session Six covers Section 6.0.0, and it describes procedures for selecting and installing various wiring devices. In addition, this session includes a review of the complete module and the module exam is administered.

1. Show the Session Six PowerPoint® presentation.
2. Use the Kickoff Activity to review wiring devices.
3. Demonstrate how to select and install receptacles.
4. Demonstrate how to select and install switches.
5. Explain the special installation needs for devices near pools, spas, and hot tubs.
6. Have the trainees complete the module review questions. Go over the review questions in class prior to the exam and answer any questions that the trainees may have.
7. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Module Twelve (26112-17) covers the applications of various types of electrical test equipment. It also describes meter safety precautions and category ratings.

### Objectives

**Learning Objective 1**
- Identify various types of electrical test equipment.
  - Identify the applications of a voltmeter.
  - Identify the applications of an ohmmeter.
  - Identify the applications of an ammeter.
  - Identify the applications of a multimeter.
  - Identify the applications of other meters.

**Learning Objective 2**
- Select a meter with the correct category rating for an application.
  - Identify electrical test equipment safety hazards.

### Performance Tasks

**Performance Task 1 (Learning Objective 2)**
- Measure the voltage in the classroom from line to neutral and neutral to ground.

**Performance Task 2 (Learning Objective 2)**
- Use an ohmmeter to measure the value of various resistors.

### Note

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### Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

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

### Prerequisites

*Core Curriculum.*

### 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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://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 requires trainees to measure the voltage in an energized system. Electrical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any safety hazards.

Classroom Equipment and Materials
Whiteboard and markers
Pencils and paper
Electrical Level One PowerPoint®
Presentation Slides
DVD player
LCD projector and screen
Computer
Internet access during class (optional)
Copy of the latest edition of the National Electrical Code®
Module Review answer key
Module Examinations
Performance Profile Sheets

Equipment and Materials for Laboratories and Performance Testing
Appropriate personal protective equipment
Analog meter
Resistors
Examples of the following test instruments with their operator’s manuals:
Voltmeter
Voltage tester

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

ABCs of DMMs, Multimeter Features and Functions Explained. Everett, WA: Fluke Corporation.
Clamp Meter ABCs. Everett, WA: Fluke Corporation.

There are a number of online resources available for trainees who would like more information on electrical test equipment. 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 26112-17

ELECTRICAL TEST EQUIPMENT

The Lesson Plan for this module is divided into two 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 and 2.0.0, and describes various types of electrical test equipment.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to introduce electrical test equipment.
3. Identify various types of electrical test equipment.
4. Select a meter with the correct category rating for an application.

SESSION TWO

Session Two is reserved for a laboratory and performance testing. In addition, this session includes a review of the complete module and administering the module exam.

1. Demonstrate how to use various types of electrical test equipment.
2. Have the trainees practice measuring the voltage in the classroom from line to neutral and neutral to ground. This laboratory corresponds to Performance Task 2.
3. Have the trainees practice using an ohmmeter to measure the value of various resistors. This laboratory corresponds to Performance Task 2.
4. Have the trainees complete the module review questions. Go over the review questions in class prior to the exam and answer any questions that the trainees may have.
5. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Module One (26201-17) describes AC circuits and explains how to apply Ohm’s law to solve for unknown circuit values. It also explains how to make power calculations in AC circuits and describes various types of transformers and how they operate.

Objectives

Learning Objective 1
- Identify AC waveforms.
  a. Define the terminology of sine waves.
  b. Define AC phase relationships.
  c. Identify nonsinusoidal waveforms.

Learning Objective 2
- Determine unknown values in AC circuits.
  a. Find unknown values in purely resistive AC circuits.
  b. Find unknown values in inductive AC circuits.
  c. Find unknown values in capacitive AC circuits.
  d. Find unknown values in combination circuits.

Learning Objective 3
- Make power calculations in AC circuits.
  a. Calculate true power.
  b. Calculate apparent power.
  c. Calculate reactive power.
  d. Calculate power factor.
  e. Use the power triangle to determine unknown values.

Learning Objective 4
- Identify transformers and explain how they operate.
  a. Identify the basic components in a transformer.
  b. Identify transformer operating characteristics.
  c. Calculate turns and voltage ratios.
  d. Identify various types of transformers and their applications.

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

Note
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Teaching Time: 17.5 hours
(Seven 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 written examination; performance testing is graded pass or fail.
Safety Considerations

This module provides an overview of AC circuits, how to determine unknown circuit values, and how to make power calculations in AC circuits. It also describes various types of transformers and how they operate. Trainees should be reminded about 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 AC circuits. Instructors must ensure that trainees clearly understand these safety considerations and clarify any weaknesses to ensure future trainee safety. Remind trainees that the safety procedures on each job site may be more stringent than OSHA or NEC® requirements.

Classroom Equipment and Materials

<table>
<thead>
<tr>
<th>Whiteboard and markers</th>
<th>DVD player</th>
<th>Module Review answer key</th>
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</thead>
<tbody>
<tr>
<td>Pencils and paper</td>
<td>LCD projector and screen</td>
<td>Module Examinations</td>
</tr>
<tr>
<td>Electrical Level Two PowerPoint®</td>
<td>Computer</td>
<td>Capacitors</td>
</tr>
<tr>
<td>Presentation Slides</td>
<td>Internet access during class (optional)</td>
<td>Transformers</td>
</tr>
</tbody>
</table>

Additional Resources

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


Online resources are available for trainees who would like more information on alternating current. 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 26201-17

ALTERNATING CURRENT

The Lesson Plan for this module is divided into seven 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 describes how to identify AC waveforms.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with alternating current and AC circuits.
3. Describe terminology associated with sine waves.
4. Describe AC phase relationships.
5. Identify nonsinusoidal waveforms.

**SESSION TWO**

Session Two covers Sections 2.0.0 through 2.2.3, and explains how to determine unknown values in purely resistive AC circuits and inductive AC circuits.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with determining unknown values in purely resistive AC circuits and inductive AC circuits.
3. Find unknown values in purely resistive AC circuits.
4. Find unknown values in inductive AC circuits.

**SESSION THREE**

Session Three covers Sections 2.3.0 through 2.3.5, and describes how to determine unknown values in capacitive AC circuits.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with determining unknown values in capacitive AC circuits.
3. Find unknown values in capacitive AC circuits.

**SESSION FOUR**

Session Four covers Sections 2.4.0 through 2.4.4, and describes how to determine unknown values in combination circuits.

1. Show the Session Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with determining unknown values in combination circuits.
3. Find unknown values in combination circuits.

**SESSION FIVE**

Session Five covers Sections 3.0.0 through 3.5.0, and describes how to calculate true power, apparent power, reactive power, and power factor, and how to use the power triangle to determine unknown values in AC circuits.

1. Show the Session Five PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with calculating true power, apparent power, reactive power, and power factor, and using the power triangle to determine unknown values in AC circuits.
3. Describe how to calculate true power.
4. Describe how to calculate apparent power.
5. Describe how to calculate reactive power.
6. Describe how to calculate power factor.
7. Describe how to use the power triangle to determine unknown values.
<table>
<thead>
<tr>
<th>Session Six</th>
<th>Session Seven</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session Six covers Sections 4.0.0 through 4.4.4, and describes how to identify transformers and explain how they operate.</td>
<td>Session Seven is a review and testing session. Have trainees complete the module Review Questions and Supplemental Exercises. Alternatively, these may be assigned as homework at the end of Session Six. Go over the module Review Questions and Supplemental Exercises in class prior to the exam and answer any questions that the trainees may have.</td>
</tr>
<tr>
<td>1. Show the Session Six PowerPoint presentation.</td>
<td>1. Have trainees complete the Module Examination.</td>
</tr>
<tr>
<td>2. Use the Kickoff Activity to encourage trainees to familiarize themselves with transformer types and operation.</td>
<td>2. Submit the results to your Training Program Sponsor through the Registry System.</td>
</tr>
<tr>
<td>3. Identify the basic components in a transformer.</td>
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<tr>
<td>4. Identify transformer operating characteristics.</td>
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<td>5. Describe how to calculate turns and voltage ratios.</td>
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<tr>
<td>6. Identify various types of transformers and their applications.</td>
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</tbody>
</table>
Module Two (26202-17) describes AC and DC motors, including their components, circuits, and connections.

**Objectives**

**Learning Objective 1**
- Identify direct current (DC) motors and describe their operating characteristics.
  a. Understand how DC motors operate.
  b. Identify types of DC motors.

**Learning Objective 2**
- Identify alternating current (AC) motors and describe their operating characteristics.
  a. Understand how AC motors operate.
  b. Identify three-phase induction motors.
  c. Identify synchronous motors.
  d. Identify single-phase induction motors.

**Learning Objective 3**
- Identify variable-speed drives and describe their operating characteristics.
  a. Identify types of adjustable speed loads.
  b. Identify types of motor speed control.
  c. Identify braking methods.

**Learning Objective 4**
- Identify motor enclosures, frame designations, and operating characteristics.
  a. Identify types of motor enclosures.
  b. Identify NEMA frame designations.
  c. Identify motor operating characteristics using nameplate data.

**Learning Objective 5**
- Identify the connections and terminal markings for AC motors.
  a. Identify the terminals of wye-connected motors.
  b. Identify the terminals of delta-connected motors.

**Learning Objective 6**
- Identify the NEC® requirements for motors.
  a. Identify NEC® installation requirements.
  b. Identify NEC® motor protection requirements.

**Performance Tasks**

**Performance Task 1 (Learning Objectives 1 and 2)**
- Identify various types of motors and their application(s).

**Performance Task 2 (Learning Objective 4)**
- Collect data from a motor nameplate.

**Performance Task 3 (Learning Objective 5)**
- Connect the terminals for a dual-voltage motor.

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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 written examination; performance testing is graded pass or fail.
**Safety Considerations**

This module provides an overview of different types of AC and DC motors and their operating characteristics. It describes various methods of motor control, different types of motor enclosures, and the information that is commonly found on motor nameplates. The connections and terminal markings for AC motors and the NEC® requirements for motor installation and protection are also examined. Trainees should be reminded about 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 AC and DC motors. Instructors must ensure that trainees clearly understand these safety considerations and clarify any weaknesses to ensure future trainee safety. Remind trainees that the safety procedures on each job site may be more stringent than OSHA or NEC® requirements.

**Classroom Equipment, Materials, and Resources**

- Whiteboard and markers
- Pencils and paper
- Electrical Level Two PowerPoint® Presentation Slides
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- DC motors, including shunt-wound, series, and compound
- Several AC motors, including some squirrel cage motors
- Capacitor-type induction motor
- Shaded-pole induction motor
- Multiple-speed induction motors
- Split-phase induction motors
- Variable-speed drives
- Motor nameplates
- NEC® installation requirements for motors
- NEC® motor protection requirements
- Ohmmeter
- Module Review answer key
- Module Examinations
- Performance Profile Sheets
- Standard eye protection
- Work gloves
- Proper footwear as designated by the instructor or training facility provider
- Hearing protection as designated by the instructor or training facility provider
- Several DC motors
- Several AC motors
- Several dual-voltage motors
- Module Review answer key
- Module Examinations
- Performance Profile Sheets
- Standard eye protection
- Work gloves
- Proper footwear as designated by the instructor or training facility provider
- Hearing protection as designated by the instructor or training facility provider
- Several DC motors
- Several AC motors
- Several dual-voltage motors

**Additional Resources**

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


An IEC Metric Motor Dimension chart can be found at [http://www.electricmotorservice.net/iechart.pdf](http://www.electricmotorservice.net/iechart.pdf).


There are a number of online resources available for trainees who would like more information on alternating current. 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.
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 1.2.3 and describes how to identify direct current (DC) motors and describe their operating characteristics.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with DC and AC motor operation.
3. Describe how DC motors operate.
4. Identify types of DC motors.

**Session Two**
Session Two covers Sections 2.0.0 through 2.2.2, and begins an examination of alternating current (AC) motors and their operating characteristics.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with AC motors and how they operate.
3. Describe how AC motors operate.
4. Identify three-phase induction motors.

**Session Three**
Session Three covers Sections 2.3.0 through 2.4.6, and completes the examination of alternating current (AC) motors and their operating characteristics.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with identifying synchronous and single-phase induction motors.
3. Identify synchronous motors.
4. Identify single-phase induction motors.

**Session Four**
Session Four covers Sections 3.0.0 through 3.3.2, and describes how to identify variable-speed drives and their operating characteristics.

1. Show the Session Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with variable-speed drives and their operating characteristics.
3. Identify types of adjustable speed loads.
4. Identify types of motor speed control.
5. Identify braking methods.
Lesson Plans for Module 26203-17

ELECTRIC LIGHTING

Module Three (26203-17) describes the principles of human vision and the characteristics of light. It describes how to identify and install incandescent, LED, fluorescent, and HID lamps and ballasts. It also examines how to select and install various types of lighting fixtures and lighting controls.

Objectives

Learning Objective 1
- Explain the relationship between human vision and light.
  a. Identify how the human eye operates.
  b. Identify the characteristics of light.

Learning Objective 2
- Identify and install lamps and ballasts.
  a. Identify and install lamps.
  b. Identify and install ballasts.

Learning Objective 3
- Select and install lighting fixtures for various applications.
  a. Identify lighting fixtures and their applications.
  b. Store and handle lamps and lighting fixtures.
  c. Install lighting fixtures.

Learning Objective 4
- Select lighting controls for various applications.
  a. Select occupancy sensors.
  b. Select photosensors.
  c. Use lighting timers.
  d. Program energy management systems.

Performance Tasks

Performance Task 1 (Learning Objective 2)
- Properly select and install lamps into lighting fixtures.

Performance Task 2 (Learning Objective 3)
- Install one or more of the following lighting fixtures and their associated lamps:
  - Surface-mounted
  - Recessed
  - Suspended
  - Track-mounted

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

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.

## Equipment, Materials, and Resources

<table>
<thead>
<tr>
<th>Whiteboard and markers</th>
<th>Different types of lighting fixtures, including:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pencils and paper</td>
<td>Surface-mounted</td>
</tr>
<tr>
<td>\textit{Electrical Level Two PowerPoint® Presentation Slides}</td>
<td>Recessed</td>
</tr>
<tr>
<td>DVD player</td>
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<td>LCD projector and screen</td>
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<td>Computer</td>
<td>Hangers and supports used with suspended lighting fixtures</td>
</tr>
<tr>
<td>Internet access during class (optional)</td>
<td>Components for a typical track lighting installation</td>
</tr>
<tr>
<td>Module Examinations</td>
<td>Occupancy sensors</td>
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<td>Performance Profile Sheets</td>
<td>Photosensors</td>
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<tr>
<td>Prism</td>
<td>Timers</td>
</tr>
<tr>
<td>Lamp manufacturers’ catalogs</td>
<td>Module Review answer key</td>
</tr>
<tr>
<td>Various types of halogen lamps</td>
<td>Standard eye protection</td>
</tr>
<tr>
<td>LED lamps</td>
<td>Work gloves</td>
</tr>
<tr>
<td>Fluorescent lamps</td>
<td>Hard hat</td>
</tr>
<tr>
<td>CFLs</td>
<td>Proper footwear as designated by the instructor or training facility provider</td>
</tr>
<tr>
<td>HID lamps</td>
<td>Hearing protection as designated by the instructor or training facility provider</td>
</tr>
<tr>
<td>Various types of ballasts</td>
<td></td>
</tr>
<tr>
<td>Outlet boxes for surface-mounted fixtures</td>
<td></td>
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<tr>
<td>Various fixture mounting assemblies and manufacturer’s instructions</td>
<td></td>
</tr>
</tbody>
</table>

## Additional Resources

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


Online resources are available for trainees who would like more information on electric lighting. 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 26203-17
ELECTRIC LIGHTING

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 2.1.7. It explains the relationship between human vision and light, and describes how to identify and install various types of lamps.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with electric lighting.
3. Describe how the human eye functions.
4. Identify the characteristics of light.
5. Explain the operation of incandescent lamps.
6. Describe how to choose light emitting diode (LED) lamps for various applications.
7. Describe how to choose fluorescent lamps for various applications.
8. Describe how to choose high-intensity discharge (HID) lamps for various applications.
9. Identify lamp color rendering and color temperature characteristics.
10. Explain how to install lamps.

**SESSION TWO**

Session Two covers Sections 2.2.0 through 3.2.0. It explains how to identify and install ballasts, and how to select lighting fixtures for various applications.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with various types of ballasts and lighting fixtures.
3. Identify and install fluorescent lighting fixture ballasts.
4. Identify and install HID lighting fixture ballasts.
5. Identify lighting fixtures and their applications.
6. Describe how to store and handle lamps and lighting fixtures.
Session Outline for Module 26203-17

ELECTRIC LIGHTING

SESSION THREE

Session Three covers Sections 3.3.0 through 3.3.5, and explains how to install various types of lighting fixtures.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with installation procedures for different types of lighting fixtures.
3. Describe how to install surface-mounted lighting fixtures.
4. Describe how to install recessed lighting fixtures.
5. Describe how to install suspended lighting fixtures.
6. Describe how to install track lighting fixtures.
7. Explain how to make electrical connections to lighting fixtures.

SESSION FOUR

Session Four covers Sections 4.0.0 through 4.4.0, and describes how to select lighting controls for various applications.

1. Show the Session Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with various types of lighting control devices.
3. Explain how to select occupancy sensors.
4. Explain how to select photosensors.
5. Describe how to use lighting timers.
6. Describe how to program energy management systems.

SESSION FIVE

Session Five is set aside for lab work needed to satisfy the module performance tasks. You can allocate lab time for these activities based on class size and available facilities. One approach would be to have some trainees complete one performance task while others work on the other performance task.

1. Have the trainees demonstrate how to properly select and install lamps into lighting fixtures.
2. Have the trainees demonstrate how to install one or more of the following lighting fixtures and their associated lamps:
   - Surface-mounted
   - Recessed
   - Suspended
   - Track-mounted

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 SIX

Session Six 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.

1. Administer the Module Examination and any outstanding performance testing.
2. Submit the results to your Training Program Sponsor through the Registry System.
Lesson Plans for Module 26204-17

CONDUIT BENDING

Module Four (26204-17) describes how to calculate and make conduit bends using mechanical, hydraulic, and electric benders.

Objectives

Learning Objective 1
• Identify the NEC® requirements for conduit bends.
  a. Identify the minimum radius requirements for various types of conduit.
  b. Calculate the number of bends per run.

Learning Objective 2
• Use equations to find bend distances.
  a. Use right-angle mathematics to find bend distances.
  b. Use the circumference of a circle to determine bend distances.

Learning Objective 3
• Use mechanical benders.
  a. Chart a mechanical bender.
  b. Make mechanical bends.

Learning Objective 4
• Use electric and hydraulic conduit benders.
  a. Use electric conduit benders.
  b. Use hydraulic conduit benders.

Learning Objective 5
• Install PVC conduit.
  a. Join PVC conduit.
  b. Bend PVC conduit.

Performance Tasks

Performance Task 1 (Learning Objectives 1–4)
• Use an electric or hydraulic bender to bend a stub-up to a precise distance above the deck.

Performance Task 2 (Learning Objectives 1–4)
• Make an offset in a length of conduit to clear an obstruction with 1” (25 mm) clearance between the pipe and the obstruction.

Performance Task 3 (Learning Objectives 1–4)
• Make a saddle in a length of conduit to cross a pipe with 1” (25 mm) clearance between the pipe and the conduit.

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 written examination; performance testing is graded pass or fail.
Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study.


There are a number of online resources available for trainees who would like more information on conduit bending. 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 26204-17
CONDUIT BENDING

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 2.2.3. It identifies the NEC® requirements for conduit bends and describes how to use mathematical equations to determine bend distances.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with conduit bending.
3. Identify the NEC® requirements for conduit bends.
4. Identify the minimum radius requirements for various types of conduit.
5. Calculate the number of bends per run.
6. Use equations to find bend distances.
7. Use right-angle mathematics to find bend distances.
8. Use the circumference of a circle to determine bend distances.

**SESSION TWO**

Session Two covers Sections 3.0.0 through 4.1.3, and explains how to use mechanical and electric conduit benders.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the procedures for bending conduit using mechanical and electric benders.
3. Chart a mechanical bender.
4. Make mechanical bends.
5. Use electric conduit benders.
Session Outline for Module 26204-17

CONDUIT BENDING

**SESSION THREE**

Session Three covers Sections 4.2.0 through 4.2.6 and describes how to use hydraulic conduit benders.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with how to bend conduit using a hydraulic bender.
3. Use hydraulic conduit benders.

**SESSION SIX**

Session Six covers Sections 5.0.0 through 5.2.0, and describes how to install PVC conduit. It also serves as a review and testing session.

1. Show the Session Six PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with installing PVC conduit.
3. Join PVC conduit.
4. Bend PVC conduit.
5. Go over the module Review Questions in class before the exam and answer any questions that the trainees may have.
6. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.

**SESSIONS FOUR AND FIVE**

These sessions are set aside for lab work needed to satisfy the module performance tasks. The lab includes the following activities:

1. Use an electric or hydraulic bender to bend a stub-up to a precise distance above the deck.
2. Make an offset in a length of conduit to clear an obstruction with 1” (25 mm) clearance between the pipe and the obstruction.
3. Make a saddle in a length of conduit to cross a pipe with 1” (25 mm) clearance between the pipe and the conduit.

You can allocate lab time for these activities based on class size and available facilities. One approach would be to have some trainees work on one activity while others work on a different activity.

Upon completion of the lab work, ask the trainees to complete the module Review Questions before the upcoming review and testing session.
Module Five (26205-17) describes how to size and install pull and junction boxes. It also identifies various specialty enclosures, including conduit bodies, FS and FD boxes, and handholes.

### Objectives

#### Learning Objective 1
- Identify boxes and fittings.
  - Select pull and junction boxes.
  - Select and install fittings.

#### Learning Objective 2
- Size pull and junction boxes.
  - Size pull and junction boxes for systems under 1,000V.
  - Size pull and junction boxes for systems over 1,000V.

#### Learning Objective 3
- Identify specialty enclosures.
  - Identify conduit bodies and other cast enclosures.
  - Select and install handholes.

### Performance Tasks

#### Performance Task 1 (Learning Objective 1)
- Identify various NEMA boxes.

#### Performance Task 2 (Learning Objective 2)
- Properly select, install, and support pull and junction boxes over 100 cu in (1,650 cu cm) in size.

#### Performance Task 3 (Learning Objective 3)
- Identify various conduit bodies and fittings.

### 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 written examination; performance testing is graded pass or fail.
Additional Resources

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


Online resources are available for trainees who would like more information on pull and junction boxes. 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.

Classroom Equipment and Materials

<table>
<thead>
<tr>
<th>Whiteboard and markers</th>
<th>Compression fittings</th>
<th>Battery-powered knockout kit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pencils and paper</td>
<td>Setscrew fittings</td>
<td>Hydraulic knockout kit</td>
</tr>
<tr>
<td><em>Electrical Level Two PowerPoint® Presentation Slides</em></td>
<td>Threaded fittings</td>
<td>Various conduit bodies</td>
</tr>
<tr>
<td>DVD player</td>
<td>Combination couplings</td>
<td>Pulling elbows</td>
</tr>
<tr>
<td>LCD projector and screen</td>
<td>Threadless metal conduit couplings</td>
<td>Entrance ells</td>
</tr>
<tr>
<td>Computer</td>
<td>Locknuts</td>
<td>Moguls</td>
</tr>
<tr>
<td>Internet access during class</td>
<td>Bushings</td>
<td>Handholes</td>
</tr>
<tr>
<td>(optional)</td>
<td>Myers hub</td>
<td>Module Review answer key</td>
</tr>
<tr>
<td>Various NEMA classifications of pull</td>
<td>Knockout punches</td>
<td>Module Examinations</td>
</tr>
</tbody>
</table>

Safety Considerations

This module identifies different types of conduit boxes, fittings, and specialty enclosures. It describes how to select and install pull and junction boxes for various applications, and it examines conduit bodies, FS and FD boxes, and handholes. Trainees should be reminded about 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. Instructors must ensure that trainees clearly understand these safety considerations and clarify any weaknesses to ensure future trainee safety. Remind trainees that the safety procedures on each job site may be more stringent than OSHA or NEC® requirements.
Session Outline for Module 26205-17
PULL AND JUNCTION BOXES

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 1.2.3 and identifies various conduit boxes and fittings.
1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with pull and junction boxes.
3. Describe how to select pull and junction boxes.
4. Describe how to select and install fittings.

**SESSION TWO**
Session Two covers Sections 2.0.0 through 2.2.0 and explains how to size pull and junction boxes. The end of the session is devoted to a laboratory and the completion of Performance Task 2.
1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the procedures for sizing pull and junction boxes for systems under 1,000V and over 1,000V.
3. Explain how to size pull and junction boxes for systems under 1,000V.
4. Explain how to size pull and junction boxes for systems over 1,000V.
5. Trainees practice and/or complete the tasks associated with Performance Task 2 to conclude the session.

**SESSION THREE**
Session Three covers Sections 3.0.0 through 3.2.2 and describes how to identify specialty enclosures, and how to select and install handholes.
1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with how to identify specialty enclosures.
3. Explain how to identify conduit bodies and other cast enclosures.
4. Explain how to select and install handholes.

**SESSION FOUR**
This session is set aside for lab work needed to satisfy Performance Task 1 and Performance Task 3. Note that there is no PowerPoint® presentation associated with this session. The lab includes the following activities:
1. Identify various NEMA boxes.
2. Identify various conduit bodies and fittings.
You can allocate lab time for these activities based on class size and available facilities. One approach would be to have some trainees work on one activity while others work on a different activity.
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.
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.
Module Six (26206-17) describes how to prepare conduit for conductors. It also explains how to set up and complete a cable-pulling operation.

### Objectives

#### Learning Objective 1
- Install cable in conduit systems.
  - a. Plan the installation.
  - b. Identify a pulling location and set up the cable reels.
  - c. Prepare raceways for conductors.
  - d. Install a pull line.
  - e. Prepare the cable ends for pulling.
  - f. Select cable-pulling equipment.

#### Learning Objective 2
- Set up for high-force cable pulling.
  - a. Set up the feeding end.
  - b. Support conductors.
  - c. Pull cable in cable trays.

#### Learning Objective 3
- Identify cable limitations when pulling.
  - a. Calculate the allowable tension on pulling devices.
  - b. Calculate the allowable tension on conductors.
  - c. Calculate the sidewall loading.

### Performance Tasks

#### Performance Task 1 (Learning Objective 3)
- Prepare multiple conductors for pulling in a raceway system.

#### Performance Task 2 (Learning Objective 3)
- Prepare multiple conductors for pulling using a wire-pulling basket.

### 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.

### Prerequisites
Core Curriculum.

### 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.

Equipment, Materials, and Resources

Whiteboard and markers
Pencils and paper
Electrical Level Two PowerPoint® Presentation Slides
DVD player
LCD projector and screen
Computer
Internet access during class (optional)
Various sizes of electrical cable
Cable strippers
Fish tape
Basket grips
Multiple conductors
Wire-pulling basket
Wire lubricant
Various types of cable pullers

Cable length meters
Circuit testers
Manufacturers’ catalogs for cable supports
Manufacturers’ literature with maximum pulling tension information
Module Review answer key
Module Examinations
Performance Profile Sheets
Standard eye protection
Work gloves
Hard hat
Proper footwear as designated by the instructor or training facility provider
Hearing protection 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.


There are a number of online resources available for trainees who would like more information on conductor installations. 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 26206-17

CONDUCTOR INSTALLATIONS

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 1.6.3 and describes how to prepare for and install cable in conduit systems.
1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with preparing for and installing cable in conduit.
3. Describe how to plan for a cable installation.
4. Identify a pulling location and set up the cable reels.
5. Explain how to prepare raceways for conductors.
6. Describe how to install a pull line.
7. Explain how to prepare the cable ends for pulling.
8. Describe how to select cable-pulling equipment.

SESSION TWO

Session Two covers Sections 2.0.0 through 2.3.0 and explains how to set up for high-force cable pulling.
1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to differentiate between a small-scale cable-pulling exercise and a high-force cable-pulling exercise.
3. Describe how to set up the feeding end.
4. Describe how to support conductors.
5. Describe how to pull cable in cable trays.

SESSION THREE

Session Three covers Sections 3.0.0 through 3.3.0 and describes how to identify cable limitations when pulling. The end of the session is devoted to a laboratory and the completion of Performance Tasks 1 and 2.
1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with limitations that must be taken into consideration when pulling cable.
3. Explain how to calculate the allowable tension on pulling devices.
4. Explain how to calculate the allowable tension on conductors.
5. Explain how to calculate the sidewall loading.
6. Have trainees practice and/or complete the tasks associated with Performance Tasks 1 and 2 to conclude the session.

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.
1. Administer the Module Examination and any outstanding performance testing.
2. Submit the results to your Training Program Sponsor through the Registry System.
Module Seven (26207-17) describes various types of cable tray, supports, and associated fittings. It also explains how to determine the loads on a cable tray and calculate fill per NEC® requirements.

### Objectives

**Learning Objective 1**
- Identify cable tray components.
  - Select cable tray fittings.
  - Identify cable tray supports.

**Learning Objective 2**
- Calculate the load on a cable tray.
  - Determine the load on supports.
  - Identify types of failure under load.
  - Identify installation requirements for cable tray.

**Learning Objective 3**
- Determine cable tray fill.
  - Determine the number of conductors allowed in cable tray operating at 2,000V or less.
  - Identify derating factors for cable tray conductors.

### Performance Tasks

**Performance Task 1 (Learning Objective 2)**
- Generate a list of materials for a cable tray layout. List all the components required, including the fasteners required to complete the system.

**Performance Task 2 (Learning Objective 2)**
- Join two straight, ladder-type cable tray sections together.

### Note

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### Teaching Time: 7.5 hours

(Three 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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://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.

Equipment, Materials, and Resources
- Whiteboard and markers
- Pencils and paper
- Electrical Level Two PowerPoint® Presentation Slides
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Sections of various types of cable tray
- Cable tray fittings and connectors
- Cable tray covers
- Splice plates
- Swivel plates
- Various types of cable tray supports
- Samples (or photos) of failed cable tray
- Various sections of cable over 4/0 AWG
- Various sections of cable under 4/0 AWG
- Various sections of multiconductor cable
- Module Review answer key
- Module Examinations
- Performance Profile sheets
- Standard eye protection
- Work gloves
- Hard hat
- Proper footwear as designated by the instructor or training facility provider
- Hearing protection 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.


There are a number of online resources available for trainees who would like more information on cable trays. 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.
The Lesson Plan for this module is divided into three 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 1.2.6. It describes what cable tray is, identifies NEC® requirements that pertain to cable tray, and identifies cable tray components.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with cable tray components and installation.
3. Explain how to select cable tray fittings.
4. Describe how to identify cable tray supports.

**SESSION TWO**

Session Two covers Sections 2.0.0 through 2.3.2, and explains how to calculate the load on a cable tray. The end of the session is devoted to a laboratory and the completion of Performance Tasks 1 and 2.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with factors that affect the load capacity of cable tray.
3. Explain how to determine the load on supports.
4. Describe how to identify types of failure under load.
5. Describe installation requirements for cable tray.
6. Have trainees practice and/or complete the tasks associated with Performance Tasks 1 and 2 to conclude the session.

**SESSION THREE**

Session Three covers Sections 3.0.0 through 3.2.0 and describes how to determine cable tray fill. It also serves as a review and testing session. Go over the module Review Questions and Supplemental Exercises in class before the exam and answer any questions before administering the exam.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with determining the number of conductors allowed in cable tray.
3. Explain how to determine the number of conductors allowed in cable tray operating at 2,000V or less.
4. Describe how to identify derating factors for cable tray conductors.
5. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Lesson Plans for Module 26208-17

CONDUCTOR TERMINATIONS AND SPLICES

Module Eight (26208-17) explains how to prepare cable ends for terminations and splices. It also describes how to train cable at termination points and describes crimping techniques.

Objectives

**Learning Objective 1**
- Strip and train conductors.
  - Strip small conductors.
  - Strip large conductors.
  - Bend cable and train conductors.

**Learning Objective 2**
- Make wire connections.
  - Install various types of connectors.
  - Make aluminum connections.
  - Install control and signal cables.

**Learning Objective 3**
- Reinsulate electrical connections.
  - Tape electrical connections.
  - Install heat-shrink insulators.
  - Use motor connection kits.

Performance Tasks

**Performance Task 1 (Learning Objectives 1 and 2)**
- Terminate conductors using selected crimp-type and mechanical-type terminals and connectors.

**Performance Task 2 (Learning Objectives 1 and 2)**
- Terminate conductors on a terminal strip.

**Performance Task 3 (Learning Objective 3)**
- Insulate selected types of wire splices and/or install a motor connection kit.

Note

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Teaching Time: 7.5 hours
(Three 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.

Equipment, Materials, and Resources

Whiteboard and markers
Pencils and paper
**Electrical Level Two** PowerPoint® Presentation Slides
DVD player
LCD projector and screen
Computer
Internet access during class (optional)
An assortment of small and large conductors (solid and stranded)
Common wire strippers for small conductors
Production-grade wire strippers
Ratchet-type strippers for large conductors
Heavy-duty strippers for large conductors
Round cable slitting and ringing tool
Ratchet bender
Hydraulic bender
Crimp-on connectors (color coded)
Mechanical connectors
Aluminum conductor connectors
Hand-operated crimping tools
Hydraulic crimping tools
Cordless crimping tools
Corded crimping tools
Universal crimping tools
Type MC cable
Weatherproof connectors for Type MC cable
Control and signal cable
Terminal blocks
Electrical tape
Heat-shrink insulators
Motor connection kits
Heat gun
Module Review answer key
Module Examinations
Performance Profile Sheets
Standard eye protection
Work gloves
Hard hat
Proper footwear as designated by the instructor or training facility provider
Hearing protection 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.


There are a number of online resources available for trainees who would like more information on conductor terminations and splicing. 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 26208-17
CONDUCTOR TERMINATIONS AND SPLICES

The Lesson Plan for this module is divided into three 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 1.3.2. It describes tools and techniques for stripping and training conductors.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with preparing and making conductor terminations and splices.
3. Explain how to strip small conductors.
4. Explain how to strip large conductors.
5. Describe how to bend cable and train conductors.

**SESSION TWO**

Session Two covers Sections 2.0.0 through 2.3.4, and explains how to make wire connections. The end of the session is devoted to a laboratory and the completion of Performance Tasks 1 and 2.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with making wire connections.
3. Explain how to install various types of connectors.
4. Describe how to make aluminum connections.
5. Explain how to install control and signal cables.
6. Have trainees practice and/or complete the tasks associated with Performance Task 1 and 2 to conclude the session.

**SESSION THREE**

Session Three covers Sections 3.0.0 through 3.3.0 and describes how to reinsulate electrical connections. The end of the session is devoted to a laboratory and the completion of Performance Task 3. It also serves as 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. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with reinsulating electrical connections.
3. Explain how to tape electrical connections.
4. Describe how to install heat-shrink insulators.
5. Describe how to use motor connection kits.
6. Have trainees practice and/or complete the tasks associated with Performance Task 3.
7. Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
Module Nine (26209-17) describes the grounding and bonding requirements of *NEC Article 250*. It also explains how to size the main and system bonding jumpers as well as the grounding electrode conductor for various AC systems.

### Objectives

**Learning Objective 1**
- Identify grounding requirements and applications.
  - a. Identify the purpose of grounding and bonding.
  - b. Identify the grounding requirements for various systems.

**Learning Objective 2**
- Identify service grounding methods.
  - a. Size and install a grounding electrode conductor.
  - b. Select other electrodes.

**Learning Objective 3**
- Size and select equipment grounding.
  - a. Size an equipment grounding conductor.
  - b. Ground an enclosure.

**Learning Objective 4**
- Bond service equipment.
  - a. Size the main bonding jumper.
  - b. Bond multiple service disconnects.
  - c. Bond enclosures and equipment.

**Learning Objective 5**
- Ground and bond separately derived systems.
  - a. Ground separately derived systems.
  - b. Install grounding at more than one building.

**Learning Objective 6**
- Test for effective grounds.
  - a. Measure earth resistance using the fall-of-potential method.
  - b. Complete a three-point test.

### Performance Tasks

**Performance Task 1 (Learning Objective 2)**
- Size the minimum required grounding electrode conductor for a 200A service fed by 3/0 copper.

**Performance Task 2 (Learning Objective 2)**
- Using the proper fittings, connect one end of a No. 4 AWG bare copper grounding wire to a length of 3/4” (MD 21) galvanized water pipe and the other end to the correct terminal in a main panelboard.

**Performance Task 3 (Learning Objective 3)**
- 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.

**Performance Task 4 (Learning Objective 3)**
- Size the minimum required equipment grounding conductor in each conduit for a 400A feeder gap using two parallel runs of 3/0 copper.

**Performance Task 5 (Learning Objective 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.

### 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
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, and Resources

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whiteboard and markers</td>
<td>An earth ground resistance tester</td>
</tr>
<tr>
<td>Pencils and paper</td>
<td>Module Review answer key</td>
</tr>
<tr>
<td>Electrical Level Two PowerPoint® Presentation Slides</td>
<td>Module Examinations</td>
</tr>
<tr>
<td>DVD player</td>
<td>Performance Profile Sheets</td>
</tr>
<tr>
<td>LCD projector and screen</td>
<td>Standard eye protection</td>
</tr>
<tr>
<td>Computer</td>
<td>Work gloves</td>
</tr>
<tr>
<td>Internet access during class (optional)</td>
<td>Hard hat</td>
</tr>
<tr>
<td>Adequate copies of all appropriate NEC® requirements, sections, and tables</td>
<td>Proper footwear as designated by the instructor or training facility provider</td>
</tr>
<tr>
<td>No. 4 AWG bare copper grounding wire</td>
<td>Hearing protection as designated by the instructor or training facility provider</td>
</tr>
</tbody>
</table>

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


There are a number of online resources available for trainees who would like more information on grounding and bonding. 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 26209-17

GROUNDING AND BONDING

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 1.2.5. It identifies grounding requirements and applications.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the use of grounding and bonding.
3. Identify the purpose of grounding and bonding.
4. Identify the grounding requirements for various systems.

**SESSION TWO**

Session Two covers Sections 2.0.0 through 2.2.0, and identifies service grounding methods. The end of the session is devoted to a laboratory and the completion of Performance Tasks 1 and 2.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with sizing a grounding electrode conductor.
3. Describe how to size and install a grounding electrode conductor.
4. Explain how to select other electrodes.
5. Have trainees practice and/or complete the tasks associated with Performance Tasks 1 and 2 to conclude the session.

**SESSION THREE**

Session Three covers Sections 3.0.0 through 3.2.2 and describes how to size and select equipment grounding. The end of the session is devoted to a laboratory and the completion of Performance Tasks 3 and 4.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with equipment grounding.
3. Explain how to size an equipment grounding conductor.
4. Describe how to ground an enclosure.
5. Have trainees practice and/or complete the tasks associated with Performance Tasks 3 and 4 to conclude the session.
Session Outline for Module 26209-17

**GROUNDING AND BONDING**

### Session Four

Session Four covers Sections 4.0.0 through 5.2.0. It explains how to bond service equipment and how to ground and bond separately derived systems. The end of the session is devoted to a laboratory and the completion of Performance Task 5.

1. Show the Session Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with bonding service equipment.
3. Describe how to size the main bonding jumper.
4. Explain how to bond multiple service disconnects.
5. Explain how to bond enclosures and equipment.
6. Describe how to ground separately derived systems.
7. Explain how to install grounding at more than one building.
8. Have trainees practice and/or complete the tasks associated with Performance Task 5 to conclude the session.

### Session Five

Session Five covers Sections 6.0.0 through 6.2.0, and describes how to test for effective grounds.

1. Show the Session Five PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with testing for effective grounds.
3. Explain how to measure earth resistance using the fall-of-potential method.
4. Describe how to complete a three-point test.

### Session Six

Session Six 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.
## Lesson Plans for Module 26210-17

### CIRCUIT BREAKERS CIRCUIT BREAKERS AND FUSES

Module Ten (26210-17) describes the operating principles of circuit breakers and fuses. It also explains how to select and install overcurrent devices.

### Objectives

**Learning Objective 1**
- Identify the function of overcurrent protective devices.
  - a. Identify types of overcurrent conditions.
  - b. Identify NEC® requirements for overcurrent protective devices.

**Learning Objective 2**
- Size and select circuit breakers.
  - a. Identify circuit breaker components.
  - b. Identify circuit breaker types and ratings.

**Learning Objective 3**
- Size and select fuses.
  - a. Identify fuse types and markings.
  - b. Size fuses.
  - c. Coordinate the operation of overcurrent protective devices.

### Performance Tasks

**Performance Task 1 (Learning Objectives 1–3)**
- Identify the following on one or more circuit breaker(s) and fuse(s):
  - Number of poles
  - Load rating
  - Voltage rating
  - Amperage interrupting rating

### 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
- Pencils and paper
- Electrical Level Two PowerPoint® Presentation Slides
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- A fuse box with fuses (if no example is available in the facility)
- Copies of the NEC® requirements for overcurrent protection
- Various sizes and types of circuit breakers
- GFCI devices
- Various Edison-base fuses
- Various Type S fuses
- Various sizes and types (single-element and dual-element) of cartridge fuses
- Module Review answer key
- Module Examinations
- Performance Profile Sheets

Equipment and Materials for Laboratories and Performance Testing
- Standard eye protection
- Work gloves
- Hard hat
- Proper footwear as designated by the instructor or training facility provider
- Hearing protection 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

There are a number of online resources available for trainees who would like more information on circuit breakers and fuses. 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.
Classroom Session 1 for Module 26210-17

CIRCUIT BREAKERS CIRCUIT BREAKERS AND FUSES

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 1.2.0. It describes the function of overcurrent protective devices, identifies types of overcurrent conditions, and identifies critical NEC® requirements for overcurrent protective devices.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with common overcurrent protective devices.
3. Identify and describe types of overcurrent conditions.
4. Identify and describe NEC® requirements for overcurrent protective devices.

**SESSION THREE**

Session Three covers Sections 3.0.0 through 3.3.0 and describes how to size and select fuses.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with various sizes and types of fuses.
3. Describe how to identify fuse types and markings.
4. Explain how to size fuses.
5. Describe how to coordinate the operation of overcurrent protective devices.

**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 activity:

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

You can allocate lab time for this activity 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 before the upcoming review and testing session.
Session Outline for Module 26210-17
CIRCUIT BREAKERS AND FUSES

SESSION FIVE

Session Five 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.

1. Administer the Module Examination and any outstanding performance testing.
2. Submit the results to your Training Program Sponsor through the Registry System.
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](http://www.nccerirc.com). For information and updates about accessing the module examinations, visit [www.nccer.org/testing](http://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
- Pencils and paper
- Electrical Level Two PowerPoint® Presentation Slides
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Magnetic contactors
- Mechanically held contactors
- Lighting contactors
- Relays
- Control relays
- Timers and timing relays
- Solid-state relays
- Thermal overload relays
- Magnetic overload relays
- Pneumatic timers
- Components of a low-voltage remote control switching system including:
  - Low-voltage relays
  - Transformers
  - Low-voltage switches
  - Master sequencer(s)
  - Drawings and schematics of low-voltage remote control switching systems
  - Module Review answer key
  - Module Examinations
  - Performance Profile Sheets

Equipment and Materials for Laboratories and Performance Testing
- Standard eye protection
- Work gloves
- Hard hat
- Proper footwear as designated by the instructor or training facility provider
- Hearing protection 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

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.
Session Outline for Module 26211-17

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.
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.
Module One (26301-17) explains how to calculate branch circuit and feeder loads for residential and commercial applications. It also covers various derating factors.

### Objectives

**Learning Objective 1**
- Calculate branch circuit loads.
  a. Calculate branch circuit ratings.
  b. Apply derating factors.
  c. Calculate branch circuit ampacity.

**Learning Objective 2**
- Identify residential branch circuit requirements.
  a. Calculate lighting loads.
  b. Calculate receptacle loads.
  c. Calculate small appliance loads.
  d. Calculate laundry circuit loads.
  e. Calculate cooking appliance loads.
  f. Calculate water heater loads.
  g. Calculate electric heating loads.
  h. Calculate air conditioning loads.

**Learning Objective 3**
- Calculate commercial loads.
  a. Calculate the loads on multi-outlet assemblies.
  b. Calculate show window loads.
  c. Calculate sign loads.
  d. Calculate loads for heavy-duty lamp holder outlets.
  e. Calculate commercial kitchen equipment loads.
  f. Calculate motor loads.
  g. Calculate welder loads.

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

### Note
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**Teaching Time: 17.5 hours**
(Seven 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 written examination; performance testing is graded pass or fail.
Safety Considerations
This module covers material that relates to trainees working with and around electrical branch and feeder circuits used in residential and commercial applications. Safety must be emphasized at all times. Any trainees in an electrical environment should be carefully observed to ensure that they 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. Any practice sessions and Performance Tasks must be completed under your direct supervision.

Classroom Equipment and Materials
Whiteboard and markers
Pencils and paper
Electrical Level Three PowerPoint® Presentation
DVD player
LCD projector and screen
Computer
Internet access during class (optional)
Module Review answer key
Module Examinations
Module Examination answer key (for paper-based exams)

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


There are a number of online resources available for trainees who would like more information on branch and feeder circuit load calculations. 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.
The Lesson Plan for this module is divided into seven 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

**Sessions One & Two**

Sessions One and Two cover Sections 1.0.0 through 1.3.0 and describe how to calculate branch circuit loads.

1. Show the Sessions One and Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with calculating branch circuit loads.
3. Explain how to calculate branch circuit ratings.
4. Explain how to apply derating factors.
5. Explain how to calculate branch circuit ampacity.

**Sessions Three & Four**

Sessions Three and Four cover Sections 2.0.0 through 2.8.0 and describe how to identify residential branch circuit requirements.

1. Show the Sessions Three and Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with identifying residential branch circuit requirements.
3. Explain how to calculate lighting loads.
4. Explain how to calculate receptacle loads.
5. Explain how to calculate small appliance loads.
6. Explain how to calculate laundry circuit loads.
7. Explain how to calculate cooking appliance loads.
8. Explain how to calculate water heater loads.
9. Explain how to calculate electric heating loads.
10. Explain how to calculate air conditioning loads.

**Sessions Five & Six**

Sessions Five and Six cover Sections 3.0.0 through 3.7.0 and describe how to calculate commercial loads.

1. Show the Sessions Five and Six PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with calculating commercial loads.
3. Explain how to calculate the loads on multi-outlet assemblies.
4. Explain how to calculate show window loads.
5. Explain how to calculate sign loads.
6. Explain how to calculate loads for heavy-duty lamp holder outlets.
7. Explain how to calculate commercial kitchen equipment loads.
8. Explain how to calculate motor loads.
9. Explain how to calculate welder loads.

**Session Seven**

Session Seven 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.

1. Have trainees complete the written examination.
2. Record the testing results as required for paper-based exams. The results for exams administered through online testing systems are recorded automatically in the Registry System.
Module Two (26302-17) explains how to select conductors for different applications and size conductors based on the expected load and voltage drop.

### Objectives

**Learning Objective 1**
- Select conductors for various applications.
  - Identify overcurrent protection for branch circuits and feeders.
  - Identify the properties of conductors.

**Learning Objective 2**
- Size conductors based on expected load and voltage drop.
  - Calculate wire sizes based on resistance.
  - Calculate conductor resistances.
  - Calculate voltage drops for various applications.

### Performance Tasks

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: 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 written examination; performance testing is graded pass or fail.
Safety Considerations

This module covers material that relates to trainees working with and around conductors used in residential and commercial applications. Safety must be emphasized at all times. Any trainees in an electrical environment should be carefully observed to ensure that they 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. Any practice sessions and Performance Tasks must be completed under your direct supervision.

Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- Electrical Level Three PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class
- Stranded conductors
- Bare and coated copper wire
- Module Review answer key
- Module Examinations

Additional Resources

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


Online resources are available for trainees who would like more information on conductor selection and calculations. 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.
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.

**SESSIONS ONE THROUGH THREE**

Sessions One through Three cover Sections 1.0.0 through 1.2.2 and describe how to select conductors for various branch applications.

1. Show the Sessions One through Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with conductor materials and types.
3. Explain how to identify overcurrent protection for branch circuits and feeders.
4. Explain how to identify the properties of conductors.

**SESSIONS FOUR & FIVE**

Sessions Four and Five cover Sections 2.0.0 through 2.3.2 and describe how to size conductors based on the expected load and voltage drop.

1. Show the Sessions Four and Five PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with calculating conductor resistance and voltage drop.
3. Explain how to calculate wire sizes based on resistance.
4. Explain how to calculate conductor resistances.
5. Explain how to calculate voltage drops for various applications.

**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.

1. Have trainees complete the written examination.
2. Record the testing results as required for paper-based exams. The results for exams administered through online testing systems are recorded automatically in the Registry System.
Lesson Plans for Module 26303-17

PRACTICAL APPLICATIONS OF LIGHTING

Module Two (26302-17) explains how to identify lamps and lighting systems, and how to select lighting systems for various applications.

Objectives

Learning Objective 1
• Identify lamps and lighting fixtures.
  a. Classify lighting by type of service and location.
  b. Identify types of lighting fixtures.

Learning Objective 2
• Select lighting systems for various applications.
  a. Identify types of lighting for various applications.
  b. Identify special-purpose wiring systems.
  c. Select dimmer systems for various applications.

Performance Tasks

Performance Task 1 (Learning Objective 1)
• Using manufacturers’ catalogs, select the appropriate lighting fixtures for specific lighting situations.

Performance Task 2 (Learning Objective 2)
• While touring selected structures to observe their lighting systems:
  – Identify the various types of lighting fixtures used.
  – Explain the specific purpose(s) served by the different fixtures.
  – Identify the lighting system class of service.

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
This module covers material that involves working with and around electrical lighting fixtures and circuits used in residential, commercial, and industrial applications. 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 Three PowerPoint® Presentation Slides*
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Specific PPE required by the site
- Various lighting manufacturers’ catalogs
- Common examples of the following types of lighting fixtures:
  - Incandescent
  - Fluorescent
  - HID
  - Outdoor
  - LED
- Vandal resistant
- Common dimmer controls
- Module Review answer key
- Module Examinations
- Performance Profile sheets

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


There are a number of online resources available for trainees who would like more information on lighting fixtures and their applications. 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 26303-17

PRACTICAL APPLICATIONS OF LIGHTING

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 1.2.5 and identifies lamps and lighting fixtures.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with different types and advantages of LED lighting for various applications.
3. Explain how lighting is classified by type of service and location.
4. Explain how to identify types of lighting fixtures.

SESSION TWO

Session Two covers Sections 2.0.0 through 2.3.5 and describes how to select lighting systems for various applications.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with factors that must be considered when selecting a lighting system for a specific application.
3. Explain how to identify types of lighting for various applications.
4. Explain how to identify special-purpose wiring systems.
5. Explain how to select dimmer systems for various applications.

SESSION THREE AND FOUR

Sessions Three and Four are set aside for lab work needed to satisfy the module Performance Tasks. You can allocate lab time for these activities based on class size and available facilities. One approach would be to have some trainees complete one performance task while other trainees work on the other performance task.

1. Using manufacturers’ catalogs, select the appropriate lighting fixtures for specific lighting situations.
2. While touring selected structures to observe their lighting systems:
   • Identify the various types of lighting fixtures used.
   • Explain the specific purpose(s) served by the different fixtures.
   • Identify the lighting system class of service.

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 FIVE

Session Five 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.
Module Four (26304-17) describes the NEC® classifications and requirements for hazardous locations.

### Objectives

#### Learning Objective 1
- Identify hazardous locations.
  - Identify Class I locations.
  - Identify Class II locations.
  - Identify Class III locations.
  - Locate NEC® requirements for hazardous locations.

#### Learning Objective 2
- Prevent ignitions and explosions in hazardous locations.
  - Identify sources of ignitions.
  - Select and install explosion-proof equipment and seals.

### Performance Task

#### Performance Task 1 (Learning Objective 2)
- Using two rigid metal conduit nipples, a sealing fitting, three pieces of No. 12 THHN conductors, and a packing fiber/sealing kit, perform the following operations:
  - Secure one conduit nipple in each end of the seal.
  - Make sure the required number of threads are engaged.
  - Pull the three THHN conductors through the nipples and seal so that about 6" (150 mm) is protruding from each nipple.
  - Pack the fiber as per the instructions furnished with the sealing kit.
  - Mix the sealing compound.
  - Position the unit in the required location and pour in the sealing compound.

### 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 may involve working in and around hazardous locations. 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.

**Equipment, Materials, and Resources**

- Whiteboard and markers
- Pencils and paper
- *Electrical Level Three* PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Specific PPE required by the site
- Various types of explosion-proof equipment, including:
  - Conduit junction boxes
  - Conduit fittings
- Flexible connectors
- Packing fiber/sealing kits
- Rigid metal conduit nipples
- Sealing fittings
- Three sections of No. 12 THHN conductors
- Packing fiber/sealing kits
- Module Review answer key
- Module Examinations
- Copies of the Performance Profile sheets

**Additional Resources**

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


There are a number of online resources available for trainees who would like more information on NEC® classifications and requirements for hazardous locations. 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 One covers Sections 1.0.0 through 1.4.4 and identifies hazardous locations.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with hazardous location classifications.
3. Explain how to identify Class I locations.
4. Explain how to identify Class II locations.
5. Explain how to identify Class III locations.
6. Explain how to locate NEC® requirements for hazardous locations.

Session Two covers Sections 2.0.0 through 2.2.3 and describes how to prevent ignitions and explosions in hazardous locations.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with equipment used to prevent ignitions and explosions in hazardous locations.
3. Explain how to identify sources of ignition.
4. Explain how to select and install explosion-proof equipment and seals.

Sessions Three through Five are set aside for lab work needed to satisfy the module Performance Task. You can allocate lab time for these activities based on class size and available facilities. One approach would be to have trainees working at multiple work stations.

1. Using two rigid metal conduit nipples, a sealing fitting, three pieces of No. 12 THHN conductors, and a packing fiber/sealing kit, perform the following operations:
   - Secure 1 conduit nipple in each end of the seal.
   - Make sure the required number of threads are engaged.
   - Pull the three THHN conductors through the nipples and seal so that about 6" (150 mm) is protruding from each nipple.
   - Pack the fiber as per the instructions furnished with the sealing kit.
   - Mix the sealing compound.
   - Position the unit in the required location and pour in the sealing compound.

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

Session Six 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.

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

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.
Module Five (26305-17) explains how to size and select circuit breakers and fuses for various applications. It also covers short circuit calculations and troubleshooting.

**Objectives**

**Learning Objective 1**
- Recognize overcurrent conditions.
  a. Identify overload conditions.
  b. Identify short circuit conditions.
  c. Identify ground faults.
  d. Identify arc faults.

**Learning Objective 2**
- Identify fuses and their applications.
  a. Identify fuse ratings.
  b. Identify types of fuses and their operating characteristics.
  c. Identify fuse classes and applications.

**Learning Objective 3**
- Identify circuit breakers and their applications.
  a. Identify circuit breaker classifications.
  b. Identify circuit breaker interrupting capacity ratings.

**Learning Objective 4**
- Size and select overcurrent devices.
  a. Select overcurrent devices for various applications.
  b. Apply short circuit calculations.

**Learning Objective 5**
- Test and troubleshoot circuit breakers and fuses.
  a. Test and troubleshoot circuit breakers.
  b. Test and troubleshoot fuses.

**Performance Tasks**
This is a knowledge-based module; there are no Performance Tasks.

**Note**
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**Teaching Time: 25 hours**
(Ten 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® presentation 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 written examination; performance testing is graded pass or fail.
Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study.


There are a number of online resources available for trainees who would like more information on circuit breakers and fuses. 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.

Classroom Equipment and Materials
- Whiteboard and markers
- Pencils and paper
- Electrical Level Three PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class
- Various types of fuses, including Class H and Class R
- Examples of fuse rejection clips
- Various types of circuit breakers
- Module Review answer key
- Module Examinations

Safety Considerations
This module covers material that relates to trainees working with and around electrical circuit breakers and fuses used in residential and commercial applications. Safety must be emphasized at all times. Any trainees in an electrical environment should be carefully observed to ensure that they 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. Any practice sessions and Performance Tasks must be completed under your direct supervision.
Session Outline for Module 26305-17

OVERCURRENT PROTECTION

The Lesson Plan for this module is divided into ten 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 1.4.0 and describes how to recognize overcurrent conditions.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with problems that can cause overcurrent conditions.
3. Explain how to identify overload conditions.
4. Explain how to identify short circuit conditions.
5. Explain how to identify ground faults.
6. Explain how to identify arc faults.

**SESSIONS TWO & THREE**

Sessions Two and Three cover Sections 2.0.0 through 2.3.5 and describe how to identify fuses and their applications.

1. Show the Sessions Two and Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with fuse ratings.
3. Explain how to identify fuse ratings.
4. Explain how to identify fuses and their operating characteristics.
5. Explain how to identify fuse classes and applications.

**SESSIONS FOUR & FIVE**

Sessions Four and Five cover Sections 3.0.0 through 3.2.0 and describe how to identify circuit breakers and their applications.

1. Show the Sessions Four and Five PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with circuit breakers used in residential, commercial, and industrial applications.
3. Explain how to identify circuit breaker classifications.
4. Explain how to identify circuit breaker interrupting capacity ratings.

**SESSIONS SIX & SEVEN**

Sessions Six and Seven cover Sections 4.0.0 through 4.2.3 and describe how to size and select overcurrent devices.

1. Show the Sessions Six and Seven PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the importance of using protective devices for short circuits and overload conditions.
3. Explain how to select overcurrent devices for various applications.
4. Explain how to apply short circuit calculations.
Lesson Plans for Module 26306-17

DISTRIBUTION EQUIPMENT

Module Six (26306-17) examines switchboards and switchgear, including NEC® requirements for installation, grounding, and maintenance. It also covers ground fault relay testing.

Objectives

Learning Objective 1
- Identify electrical distribution system components.
  a. Identify switchboard components and installation requirements.
  b. Identify switchgear components and installation requirements.
  c. Identify the operation and applications of high-voltage limiting (HVL) switches.
  d. Identify the operation and applications of bolted pressure switches.
  e. Identify various transformers and their applications.
  f. Identify panelboard arrangements for various applications.

Learning Objective 2
- Identify the installation requirements for distribution equipment.
  a. Identify the NEC® requirements for distribution equipment.
  b. Interpret electrical diagrams related to the installation of distribution equipment.

Learning Objective 3
- Test and maintain switchgear.
  a. Describe the general maintenance guidelines for switchboards and switchgear.
  b. List the test guidelines for switchboards and switchgear.
  c. Identify the devices used to monitor power distribution systems for ground faults.

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

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.
Additional Resources

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


There are a number of online resources available for trainees who would like more information on electrical distribution equipment. 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 26306-17

**DISTRIBUTION EQUIPMENT**

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 1.6.5 and identifies electrical distribution system components.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the basic layout and components of an electrical distribution system.
3. Identify switchboard components and installation requirements.
4. Identify switchgear components and installation requirements.
5. Describe the operation and applications of high-voltage limiting (HVL) switches.
6. Describe the operation and applications of bolted pressure switches.
7. Identify various transformers and their applications.
8. Identify panelboard arrangements for various applications.

### Session Two

Session Two covers Sections 2.0.0 through 2.2.7 and identifies the installation requirements for distribution equipment.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the NEC® requirements that pertain to the installation of distribution equipment.
3. Identify the NEC® requirements for distribution equipment.
4. Explain how to interpret electrical diagrams related to the installation of distribution equipment.

### Sessions Three and Four

Sessions Three and Four cover Sections 3.0.0 through 3.3.7 and describe how to test and maintain switchgear.

1. Show the Sessions Three and Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the use of infrared thermography for detecting temperature abnormalities in electrical equipment.
3. Describe the general maintenance guidelines for switchboards and switchgear.
4. List the test guidelines for switchboards and switchgear.
5. Identify the devices used to monitor power distribution systems for ground faults.

### 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.

Administer the Module Examination and submit the results to your Training Program Sponsor through the Registry System.
Module Seven (26307-17) describes the construction, operation, and applications of various transformers. It also covers transformer connections and grounding requirements.

### Objectives

**Learning Objective 1**
- Identify the construction and operation of a transformer.
  - a. Explain the operation of a typical transformer.
  - b. Describe the construction of a typical transformer.
  - c. Make transformer connections for various applications.

**Learning Objective 2**
- Apply the NEC® requirements for transformers and capacitors.
  - a. Identify the NEC® requirements for transformers.
  - b. Identify the NEC® requirements for capacitors.
  - c. Identify the NEC® requirements for resistors and reactors.

**Learning Objective 3**
- Troubleshoot and maintain transformers.
  - a. Identify common transformer problems.
  - b. Perform transformer testing and maintenance.

### Performance Tasks

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

### 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 written examination; performance testing is graded pass or fail.
**Safety Considerations**

This module covers material that relates to trainees working with and around transformers and related equipment in commercial and industrial applications. Safety must be emphasized at all times. Any trainees in an electrical environment should be carefully observed to ensure that they 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. Any practice sessions and Performance Tasks must be completed under your direct supervision.

**Classroom Equipment and Materials**

- Whiteboard and markers
- Pencils and paper
- *Electrical Level Three PowerPoint*® Presentation Slides
- DVD player
- LCD projector and screen
- Computer
- Internet access during class
- Module Review answer key
- Module Examinations
- Module Examination answer key

**Additional Resources**

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


There are a number of online resources available for trainees who would like more information on transformers and related equipment. 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 26307-17

TRANSFORMERS

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 1.3.9 and identifies the construction and operation of a transformer.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the basic construction and operation of a transformer.
3. Explain the operation of a typical transformer.
4. Describe the construction of a typical transformer.
5. Discuss how to make transformer connections for various applications.

**SESSION TWO**

Session Two covers Sections 2.0.0 through 2.3.0 and explains how to apply the NEC® requirements for transformers and capacitors.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the four-letter designations that indicate how the internal medium of a transformer is cooled.
3. Identify the NEC® requirements for transformers.
4. Identify the NEC® requirements for capacitors.
5. Identify the NEC® requirements for resistors and reactors.

**SESSION THREE & FOUR**

Sessions Three and Four cover Sections 3.0.0 through 3.2.2 and describe how to troubleshoot and maintain transformers.

1. Show the Sessions Three and Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the importance of transformer testing and maintenance.
3. Identify common transformer problems.
4. Discuss how to perform transformer testing and maintenance.

**SESSION FIVE**

Session Five 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.

1. Have trainees complete the written examination.
2. Record the testing results as required for paper-based exams. The results for exams administered through online testing systems are recorded automatically in the Registry System.
Module Eight (26308-17) describes the components, installation considerations, and NEC® requirements for commercial electrical services.

Objectives

Learning Objective 1
- Identify installation considerations for commercial services.
  a. Identify service components.
  b. Locate NEC® requirements for commercial services.

Learning Objective 2
- Install commercial services.
  a. Install overhead services.
  b. Install underground services.
  c. Install switchgear.
  d. Install multi-family services.

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

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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
This module covers material that involves working with and around commercial electrical services. 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.

Classroom Equipment and Materials
Whiteboard and markers
Pencils and paper
**Electrical Level Three PowerPoint® Presentation**
DVD player
LCD projector and screen
Computer
Internet access during class (optional)
Module Review answer key
Module Examinations

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


There are a number of online resources available for trainees who would like more information on commercial electrical services. 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.
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 1.2.4 and identifies installation considerations for commercial services.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with components common to a typical commercial service.
3. Identify and discuss service components.
4. Locate and discuss NEC® requirements for commercial services.

**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.

Administer the Module Examination and submit the results to your Training Program Sponsor through the Registry System.

**SESSIONS TWO AND THREE**

Sessions Two and Three cover Sections 2.0.0 through 2.4.0. They explain how to install commercial services.

1. Show the Sessions Two and Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the general procedures involved in installing commercial services.
3. Discuss how to install overhead services.
4. Discuss how to install underground services.
5. Discuss how to install switchgear.
6. Discuss how to install multi-family services.
Module Nine (26309-17) describes the calculations required to size the conductors and overcurrent protection required for motor applications.

### Learning Objective 1
- Identify motor connections and operating characteristics.
  - Calculate synchronous speed.
  - Identify stator windings.

### Learning Objective 2
- Size motor circuit conductors.
  - Calculate conductor ampacities for a typical motor control center.
  - Calculate conductor ampacities for other motor applications.

### Learning Objective 3
- Size motor protective devices.
  a. Size fuses for short circuit protection.
  b. Size overcurrent protection for oversized motors.
  c. Size motor overload protection.
  d. Size short circuit protection for use with motor starters.
  e. Size protective devices for multi-motor branch circuits.
  f. Size equipment grounding conductors.
  g. Install capacitors for power factor correction.

### Performance Tasks
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: 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 written examination; performance testing is graded pass or fail.
Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study.

There are a number of online resources available for trainees who would like more information on electric motors and ampacity calculations associated with sizing electrical conductors and devices. 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.
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 Outline for Module 26309-17

**MOTOR CALCULATIONS**

### Session One

Session One covers Sections 1.0.0 through 1.2.2 and identifies motor connections and operating characteristics.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the principles and benefits of three-phase electricity and its use in motors.
3. Explain how to calculate synchronous speed.
4. Identify and discuss stator windings.

### Session Two

Session Two covers Sections 2.0.0 through 2.2.3 and explains how to size motor circuit conductors.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the proper sequence of steps involved in sizing motor circuit conductors.
3. Discuss how to calculate conductor ampacities for a typical motor control center.
4. Discuss how to calculate conductor ampacities for other motor applications.

### Sessions Three & Four

Sessions Three and Four cover Sections 3.0.0 through 3.7.0 and explain how to size motor protective devices.

1. Show the Sessions Three and Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with short circuits and overloads and devices used to protect motors from these conditions.
3. Discuss how to size fuses for short circuit protection.
4. Discuss how to size overcurrent protection for oversized motors.
5. Discuss how to size motor overload protection.
6. Discuss how to size short circuit protection for use with motor starters.
7. Discuss how to size protective devices for multi-motor branch circuits.
8. Discuss how to size equipment grounding conductors.
9. Discuss how to install capacitors for power factor correction.
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. Have trainees complete the written examination.

2. Record the testing results as required for paper-based exams. The results for exams administered through online testing systems are recorded automatically in the Registry System.
Module Ten (26310-17) covers the installation, termination, and testing of voice, data, and video cabling systems.

### Objectives

#### Learning Objective 1
- Install structured cabling systems.
  - Install campus backbone subsystems.
  - Install equipment/telecom room subsystems.
  - Install riser subsystems.
  - Install horizontal subsystems.
  - Install work area subsystems.

#### Learning Objective 2
- Install and terminate various types of cable.
  - Terminate UTP jacks and plugs.
  - Terminate RG6 F-type coaxial cable.
  - Install fiber-optic cable.
  - Ground and test VDV systems.

### Performance Tasks
- 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 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 provides an overview of the procedures used to install, terminate, and test voice, data, and video cabling systems. Instructors must ensure that trainees understand the importance of wearing the proper PPE, following safe practices, and giving due respect to any hazards that may be present when performing these tasks. 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
Pencils and paper
*Electrical Level Three* PowerPoint® Presentation
DVD player
LCD projector and screen
Computer
Internet access during class (optional)
Stripping tool and connectors
Module Review answer key
Module Examinations

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


There are a number of online resources available for trainees who would like more information on voice, data, and video cabling 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 26310-17

VOICE, DATA, AND VIDEO

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 1.5.4 and describes how to install structured cabling systems.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to consider the benefits of properly designed and installed structured cabling.
3. Describe how to install campus backbone subsystems.
4. Describe how to install equipment/telecom room subsystems.
5. Describe how to install riser subsystems.
6. Describe how to install horizontal subsystems.
7. Describe how to install work area subsystems.

**SESSION TWO**

Session Two covers Sections 2.0.0 through 2.2.0 and describes how to terminate unshielded twisted pair (UTP) and coaxial cable.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to familiarize trainees with the range of tools that may typically be used when terminating UTP and coaxial cable.
3. Describe how to terminate UTP jacks and plugs.
4. Describe how to terminate RG6 F-type coaxial cable.

**SESSION THREE**

Session Three covers Sections 2.3.0 through 2.4.2 and describes how to install fiber-optic cable.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the basic composition and capabilities of optical fiber.
3. Describe how to install fiber-optic cable in trays and ducts.
4. Describe how to install fiber-optic cable in conduit.
5. Describe how to install fiber-optic system components.

**SESSION FOUR**

Session Four is a review and testing session. Have trainees complete the Module Review questions and Supplemental Exercises. Alternatively, these may be assigned as homework at the end of Session Three.

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 submit the results to your Training Program Sponsor through the Registry System.
Module Eleven (26311-17) provides information on selecting, sizing, and installing motor controllers. It also covers control circuit pilot devices and basic relay logic.

**Objectives**

**Learning Objective 1**
- Identify relays and contactors.
  a. Identify electromechanical relays.
  b. Identify magnetic contactors.
  c. Identify types of motor overload protection.

**Learning Objective 2**
- Select magnetic and manual motor starters.
  a. Select NEMA magnetic contactors/motor starters.
  b. Select IEC magnetic contactors/motor starters.
  c. Identify contactor/motor starter accessories.

**Learning Objective 3**
- Identify control transformers and pilot devices.
  a. Identify control transformers.
  b. Identify switches, sensors, and pilot lights.

**Learning Objective 4**
- Identify installation considerations for motor controls.
  a. Select motor enclosures.
  b. Interpret installation diagrams.
  c. Identify NEC® regulations for motor control circuits.
  d. Connect motor controllers for specific applications.

**Performance Task**

**Performance Task 1 (Learning Objective 4)**
- Make all connections for a magnetic motor controller, controlled by two pushbutton stations, including the connections for holding the circuit interlock.

**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

This module provides an overview of motor controls, control circuit pilot devices, and basic relay logic. Instructors must ensure that trainees understand the importance of wearing the proper PPE, following safe practices, and giving due respect to any hazards that may be present when working with or in the vicinity of motors and motor controllers. 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. Practice sessions and Performance Tasks must be completed under your direct supervision.

Classroom Equipment and Materials

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Whiteboard and markers</td>
<td>Magnetic and manual motor starters</td>
</tr>
<tr>
<td>Pencils and paper</td>
<td>Contactor/motor starter accessories</td>
</tr>
<tr>
<td>Electrical Level Three PowerPoint®</td>
<td>Control transformers</td>
</tr>
<tr>
<td>DVD player</td>
<td>Pushbutton switches (including one for disassembly)</td>
</tr>
<tr>
<td>LCD projector and screen</td>
<td>Selector switches (including joystick-operated types)</td>
</tr>
<tr>
<td>Computer</td>
<td>Pushbutton stations</td>
</tr>
<tr>
<td>Internet access during class</td>
<td>Pilot lights/pilot light assemblies</td>
</tr>
<tr>
<td>(optional)</td>
<td>Temperature switches</td>
</tr>
<tr>
<td>Specific PPE required by the site</td>
<td>Pressure switches</td>
</tr>
<tr>
<td>Power relays</td>
<td>Limit switches</td>
</tr>
<tr>
<td>Mechanical contactors (including one for disassembly)</td>
<td>Flow switches</td>
</tr>
<tr>
<td>Overload relays (including a melting-alloy overload relay and a bimetallic overload relay for disassembly)</td>
<td>Float switches</td>
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<tr>
<td></td>
<td>Foot switches</td>
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<tr>
<td></td>
<td>Jogging and plugging switches</td>
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<tr>
<td></td>
<td>Proximity switches/sensors</td>
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<tr>
<td></td>
<td>Photoelectric switches/sensors</td>
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<tr>
<td></td>
<td>Drum switches</td>
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<tr>
<td></td>
<td>NEMA enclosures</td>
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<tr>
<td></td>
<td>Several magnetic motor controllers, each of which is controlled by two pushbutton stations</td>
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<tr>
<td></td>
<td>Tools and connections needed for making all connections for each magnetic motor controller, including the connections for holding the circuit interlock</td>
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<tr>
<td></td>
<td>Module Review answer key</td>
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<tr>
<td></td>
<td>Module Examinations</td>
</tr>
<tr>
<td></td>
<td>Performance Profile Sheets</td>
</tr>
</tbody>
</table>

Additional Resources

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


There are a number of online resources available for trainees who would like more information on motor controls and basic relay logic. 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 26311-17

MOTOR CONTROLS

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 1.3.3 and describes how to identify relays and contactors.
1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with electromechanical relays and how they operate.
3. Describe how to identify electromechanical relays.
4. Describe how to identify magnetic contactors.
5. Describe how to identify types of motor overload protection.

**SESSION TWO**

Session Two covers Sections 2.0.0 through 3.2.5. It describes how to select magnetic and manual motor starters and begins a discussion of how to identify control transformers and pilot devices.
1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with magnetic motor starters and how they operate.
3. Describe how to select NEMA magnetic contactors/motor starters.
4. Describe how to select IEC magnetic contactors/motor starters.
5. Describe how to identify contactor/motor starter accessories.
6. Identify and describe control transformers.
7. Identify and describe the following: pushbutton switches, selector switches, pushbutton stations, pilot lights, temperature switches, and pressure switches.

**SESSION THREE**

Session Three covers Sections 3.2.6 through 3.2.12 and concludes the discussion of how to identify control transformers and pilot devices.
1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to review the pilot devices that were covered in Session Two and encourage trainees to familiarize themselves with several additional switches/sensors that are used in motor control circuits.
3. Identify and describe the following types of switches: limit switches, flow switches, float switches, foot switches, jogging and plugging switches, proximity switches/sensors, photoelectric switches/sensors, and drum switches.
Session Outline for Module 26311-17

MOTOR CONTROLS

SESSION FOUR

Session Four covers Sections 4.0.0 through 4.4.6 and describes how to identify installation considerations for motor controls. The session ends with a lab exercise to satisfy the module performance task.

1. Show the Session Four PowerPoint® presentation.
2. Use the Kickoff Activity to engage trainees in considering the consequences of inadequate planning when installing motor controllers.
3. Explain how to select motor enclosures.
4. Explain how to interpret installation diagrams.
5. Identify NEC® regulations for motor control circuits.
6. Describe how to connect motor controllers for specific applications.
7. Demonstrate how to make connections for a magnetic motor controller controlled by two pushbutton stations, including the connections for holding the circuit interlock.
8. Have the trainees demonstrate how to make all connections for a magnetic motor controller controlled by two pushbutton stations, including the connections for holding the circuit interlock. This laboratory corresponds to Performance Task 1.
9. Have the trainees review the entire module and complete the Module Review questions and Supplemental Exercises before the upcoming review and testing session.

SESSION FIVE

Session Five 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.

1. Administer the Module Examination and any outstanding performance testing.
2. Submit the results to your Training Program Sponsor through the Registry System.
Module One (26401-17) examines basic load calculations for residential and commercial applications, including raceway fill, conductor derating, and voltage drop.

Objectives

Learning Objective 1
- Perform basic load calculations in accordance with National Electrical Code® (NEC®) requirements.
  a. Make adjustments in conductor size for various installations.
  b. Calculate feeder ampacity.
  c. Apply tap rules.
  d. Apply demand factors.

Learning Objective 2
- Make service calculations for residential installations.
  a. Calculate the minimum service size for simple electrical installations.
  b. Make service calculations for single-family dwellings.
  c. Make service calculations for multi-family dwellings.

Learning Objective 3
- Make service calculations for commercial installations.
  a. Size commercial and industrial lighting loads.
  b. Calculate loads for retail stores.
  c. Calculate loads for office buildings.
  d. Calculate loads for restaurants.
  e. Calculate loads for hotels and motels.
  f. Perform optional calculations for schools.
  g. Size shore power circuits for marinas and boatyards.
  h. Make farm load calculations.
  i. Size motor circuits.

Performance Tasks
This is a knowledge-based module. There are Performance Tasks.

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 written examination; performance testing is graded pass or fail.
Safety Considerations

This module covers material that relates to trainees working with and around electrical circuits and equipment used in residential and commercial applications. Safety must be emphasized at all times. Any trainees in an electrical environment should be carefully observed to ensure that they 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. Any 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
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations

Additional Resources

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


There are a number of online resources available for trainees who would like more information on load calculations for feeders and services. 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 26401-17

LOAD CALCULATIONS – FEEDERS AND SERVICES

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 1.1.3 and describes how to perform basic load calculations in accordance with National Electrical Code® (NEC®) requirements and make adjustments in conductor size.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the calculations needed to determine load center length.
3. Explain how to make adjustments in conductor size for various installations.

**SESSION TWO**

Session Two covers Sections 1.2.0 through 1.4.3 and describes how to calculate feeder ampacity and apply tap rules and demand factors.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the calculations needed to determine feeder ampacity.
3. Explain how to calculate feeder ampacity.
4. Explain how to apply tap rules.
5. Explain how to apply demand factors.

**SESSION THREE**

Session Three covers Sections 2.0.0 through 2.1.2 and describes how to make service calculations for simple electrical installations.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with using different multiplication factors when determining the general lighting load for different areas of a commercial facility.
3. Describe the steps for determining the service load for a building.
4. Explain how to calculate the load for a small rural pump house.
5. Explain how to calculate the load for a roadside vegetable stand.

**SESSION FOUR**

Session Four covers Sections 2.2.0 through 2.3.2 and describes how to make service calculations for residential installations.

1. Show the Session Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with factors that must be taken into consideration when calculating the area of occupancy (net living space) for the single-family dwelling.
3. Explain how to make service calculations for single-family dwellings.
4. Explain how to make service calculations for multi-family dwellings.
Session Outline for Module 26401-17

LOAD CALCULATIONS – FEEDERS AND SERVICES

**SESSION FIVE**

Session Five covers Sections 3.0.0 through 3.3.2 and describes how to size commercial and industrial lighting loads and calculate loads for retail stores and office buildings.

1. Show the Session Five PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the basic load types identified by the NEC® that pertain to calculating loads for commercial occupancies.
3. Explain how to size commercial and industrial lighting loads.
4. Explain how to calculate loads for retail stores.
5. Explain how to calculate loads for office buildings.

**SESSION SIX**

Session Six covers Sections 3.4.0 through 3.6.0 and describes how to make service calculations for restaurants, hotels and motels, and schools.

1. Show the Session Six PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with NEC® minimum load values that must be used during service calculations for commercial facilities.
3. Explain how to calculate loads for restaurants.
4. Explain how to calculate loads for hotels and motels.
5. Explain how to perform optional calculations for schools.

**SESSION SEVEN**

Session Seven covers Sections 3.7.0 through 3.9.0 and describes how to make service calculations for marinas and boatyards, farms, and motor circuits.

1. Show the Session Seven PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with applications where two or more motors are connected to the same feeder circuit to lower costs and maintain efficiency.
3. Explain how to size shore power circuits for marinas and boatyards.
4. Explain how to make farm load calculations.
5. Explain how to size motor circuits.

**SESSION EIGHT**

Session Eight 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. Have trainees complete the written examination.
2. Record the testing results as required for paper-based exams. The results for exams administered through online testing systems are recorded automatically in the Registry System.
Lesson Plans for Module 26402-17

HEALTH CARE FACILITIES

Module Two (26402-17) examines the installation of electrical systems in health care facilities, including the requirements for life safety and critical circuits.

### Objectives

**Learning Objective 1**
- List the types of health care facilities and their power requirements.
  - a. Identify types of essential electrical systems used in health care facilities.
  - b. Identify types of distribution systems used in health care facilities.

**Learning Objective 2**
- Describe the categories and branch portions of the distribution circuits.
  - a. Describe the operation and applications of hospital-grade receptacles.
  - b. Identify the receptacle requirements for general care (Category 2) spaces.
  - c. Identify the receptacle requirements for critical care (Category 1) spaces.
  - d. Identify the grounding requirements for receptacles and fixed electrical equipment.

**Learning Objective 3**
- List the required wiring methods in health care facilities.
  - a. Identify the wiring requirements for inhalation anesthetizing locations.
  - b. Identify the wiring requirements for low-voltage equipment and instruments.
  - c. Identify the wiring requirements for X-ray installations.
  - d. Identify the requirements for communication, signaling, data, and fire alarm systems installed in patient care areas.
  - e. Identify the requirements for isolated power systems.

### Performance Tasks

This is a knowledge-based module. There are Performance Tasks.

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**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 from [www.nccerirc.com](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://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 covers material that involves electrical circuits and equipment used in health care 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.

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**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)
- Module Review answer key
- Module Examinations

**Additional Resources**

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


There are a number of online resources available for trainees who would like more information on electrical systems in health care facilities. 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 26402-17

HEALTH CARE FACILITIES

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 1.2.4 and identifies different types of health care facilities and their electrical power requirements.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the electrical requirements for different areas of hospitals and health care facilities.
3. Identify and discuss essential electrical systems used in health care facilities.
4. Identify and discuss different types of distribution systems used in health care facilities.

**SESSION TWO**

Session Two covers Sections 2.0.0 through 2.4.0 and describes the categories and branch portions of the distribution circuits used in health care facilities.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with how electrical power is distributed throughout a health care facility.
3. Describe the operation and applications of hospital-grade receptacles.
4. Identify the receptacle requirements for general care (Category 2) spaces.
5. Identify the receptacle requirements for critical care (Category 1) spaces.
6. Identify the grounding requirements for receptacles and fixed electrical equipment.

**SESSION THREE**

Session Three covers Sections 3.0.0 through 3.5.2 and describes the required wiring methods for health care facilities.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the wiring requirements and equipment used in different areas of a health care facility.
3. Identify and describe the wiring requirements for inhalation anesthetizing locations.
4. Discuss the wiring requirements for low-voltage equipment and instruments.
5. Describe the wiring requirements for X-ray installations.
6. Identify and describe the requirements for communication, signaling, data, and fire alarm systems installed in patient care areas.
7. Identify and describe the requirements for isolated power systems.

**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.

1. Administer the Module Examination.
2. Submit the results to your Training Program Sponsor through the Registry System.
Module Three (26403-17) explains the NEC® installation requirements for electric generators and storage batteries.
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
- Pencils and paper
- Electrical Level Four PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Engine-driven AC generator
- Transfer switches
- Storage batteries
- Battery charger
- Tools to perform resistance and capacity checks on batteries
- Chemical-resistant goggles and face shield
- Acid-resistant or alkali-resistant gloves
- Chemical-resistant protective aprons and overshoes
- Portable or stationary water facilities for rinsing eyes and skin in case of contact with electrolyte
- Acid- or alkali-neutralizing solution
- Insulated tools
- Class C fire extinguisher or other type as recommended by the battery manufacturer
- Respirator, if required
- Module Review answer key
- Module Examinations

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


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.
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.
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.
  - Explain basic electronic theory.
  - Explain semiconductor fundamentals.

**Learning Objective 2**
- Identify and describe semiconductor devices.
  - Describe the operation and uses of diodes.
  - Describe the operation and uses of transistors.
  - 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**

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

**Additional Resources**

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


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.
Lesson Plans for Module 26405-17

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.

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<thead>
<tr>
<th>Objectives</th>
<th>Learning Objective 4</th>
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<td>Identify and describe approaches to fire alarm</td>
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<td>notification and communication/monitoring.</td>
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<td>Learning Objective 1</td>
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<td>devices and systems.</td>
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<td>b. Describe important considerations in the</td>
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<td>use of fire alarm notification signals.</td>
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<td>c. Describe communication and monitoring</td>
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<td>options for fire alarm systems.</td>
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<td>Learning Objective 2</td>
<td>Describe fire alarm system installation</td>
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<td></td>
<td>guidelines and requirements.</td>
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<td></td>
<td>a. Describe the general wiring requirements.</td>
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<td>b. Describe the general installation</td>
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<td>requirements for wiring and various</td>
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<td>components.</td>
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<td></td>
<td>c. Describe the installation guidelines for</td>
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<td>totally protected premises.</td>
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<td>d. Describe the installation guidelines for</td>
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<td>fire alarm-related systems and devices.</td>
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<td></td>
<td>e. Describe how to troubleshoot fire alarm</td>
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<td></td>
<td>systems.</td>
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<tr>
<td>Learning Objective 3</td>
<td>Connect selected fire alarm system(s).</td>
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</tbody>
</table>

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.

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**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
- 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

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**Additional Resources**

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


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.
Session Outline for Module 26405-17

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.
Module Six (26406-17) covers various types of transformers and their applications. It also provides information on selecting, sizing, and installing this equipment.

### Objectives

**Learning Objective 1**
- Identify and describe various types of transformers.
  - a. Identify common transformer types.
  - b. Explain how three-phase transformers can be wired internally.
  - c. Identify types of specialty transformers.

**Learning Objective 2**
- Identify instrument transformers.
  - a. Identify and describe the use of current transformers.
  - b. Identify and describe the use of potential transformers.

**Learning Objective 3**
- Define harmonics and explain how harmonic issues are identified and resolved.
  - a. Describe the common sources of harmonics in office buildings and industrial plants.
  - b. Explain how to survey a system to identify the source of harmonics.
  - c. Explain how to resolve harmonics.

### Performance Tasks

**Performance Task 1 (Learning Objective 1)**
- Identify various specialty transformers.

**Performance Task 2 (Learning Objective 1)**
- Connect a buck-and-boost transformer to a single-phase circuit so that it will first be in the boost mode and then in the buck mode. Record the voltage increase and decrease for each configuration.

**Performance Task 3 (Learning Objective 2)**
- Using a clamp-on ammeter, demonstrate the principles of a current transformer; identify the primary winding, and then calculate and measure the effects of increasing the number of turns (loops) in the primary winding.

### 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
- Pencils and paper
- Electrical Level Four PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Standard eye protection and work gloves for handling components
- Potential (voltage) and current transformers
- Various specialty transformers, including one or more buck-and-boost transformers
- Clamp-on ammeter
- Multimeter
- Single-phase circuit
- Module Review answer key
- Module Examinations
- Copies of the Performance Profile sheets

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


There are a number of online resources available for trainees who would like more information on specialty transformers. 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 26406-17

SPECIALTY TRANSFORMERS

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 1.3.8. It describes how to identify various types of transformers.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with transformer operation.
3. Identify common transformer types.
4. Explain how three-phase transformers can be wired internally.
5. Identify types of specialty transformers.
6. Demonstrate how to connect a buck-and-boost transformer to a single-phase circuit so that it will first be in the boost mode and then in the buck mode. Record the voltage increase and decrease for each configuration.
7. Have the trainees practice identifying transformers and making connections for buck-and-boost transformers. These activities correspond to Performance Tasks 1 and 2.
8. Document successful Performance Task completions for each trainee on the Performance Profile Sheet and submit the results to the Training Program Sponsor.

SESSION TWO

Session Two covers Sections 2.0.0 through 2.2.0. It describes how to identify instrument transformers.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with instrument transformers.
3. Identify and describe the use of current transformers.
4. Identify and describe the use of potential transformers.
5. Using a clamp-on ammeter, demonstrate the principles of a current transformer; identify the primary winding, and then calculate and measure the effects of increasing the number of turns (loops) in the primary winding.
6. Have the trainees practice demonstrating the principles of a current transformer using a clamp-on ammeter. This activity corresponds to Performance Task 3.
7. Document successful Performance Task completions for each trainee on the Performance Profile Sheet and submit the results to the Training Program Sponsor.
Session Outline for Module 26406-17

SPECIALTY TRANSFORMERS

SESSION THREE

Session Three covers Sections 3.0.0 through 3.3.2. It describes how to identify and resolve harmonics.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with harmonics.
3. Describe the common sources of harmonics in office buildings and industrial plants.
4. Explain how to survey a system to identify the source of harmonics.
5. Explain how to resolve harmonics.

SESSION FOUR

Session Four 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.

Administer the Module Examination and any outstanding performance testing, and submit the results to your Training Program Sponsor through the Registry System.
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.
Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study.


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.
Session Outline for Module 26407-17

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.
## Session Outline for Module 26407-17

### 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.

### 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.

### 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.
Module Eight (26408-17) provides a basic overview of HVAC systems and their controls. Electrical troubleshooting and NEC® requirements are emphasized.

**Objectives**

**Learning Objective 1**
- Describe the operating principles and major components of HVAC systems.
  a. Describe the basic principles of heating and ventilation.
  b. Describe the basic principles and components of comfort air conditioning systems.

**Learning Objective 2**
- Identify the types of thermostats and their uses.
  a. State the operating principles of thermostats.
  b. Install different types of thermostats.

**Learning Objective 3**
- Identify and describe HVAC control systems and devices.
  a. Identify and describe controls used in comfort cooling systems.
  b. Identify and describe furnace controls.
  c. Identify and describe heat pump defrost controls.
  d. Describe digital controls used in HVAC systems.
  e. Analyze the operating sequences of various HVAC control systems.
  f. Describe troubleshooting methods used for HVAC systems.

**Learning Objective 4**
- Identify the NEC® requirements that apply to HVAC systems.
  a. Identify the NEC® requirements that apply to HVAC controls.
  b. Identify the NEC® requirements that apply to HVAC equipment.

**Performance Tasks**

**Performance Task 1 (Learning Objective 2)**
- Identify various types of thermostats and describe their operation and uses.

**Performance Task 2 (Learning Objective 2)**
- Install a conventional 24V bimetal thermostat, and hook it up using the standard coding system for thermostat wiring.

**Performance Task 3 (Learning Objective 2)**
- Check and adjust a thermostat, including the heat anticipator setting and indicator adjustment.

**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 HVAC 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)
Specific PPE required by the site
The following types of thermostats:
  Mechanical
  Electronic
  Programmable electronic
  Heating-only
  Cooling-only
  Heating-cooling
  Automatic-changeover
  Multistage
  Tools needed to install a conventional 24V bimetal thermostat
  Tools needed to check and adjust a thermostat
  Copies of Refrigeration and Air Conditioning: An Introduction to HVAC/R, Latest Edition
  Copies of ABC’s of Air Conditioning, Latest Edition
  Copies of System Diagnostics and Troubleshooting Procedures, Latest Edition
  Module Review answer key
  Module Examinations
  Performance Profile sheets

Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study.
ABC’s of Air Conditioning. Syracuse, NY: Carrier Corporation.

There are a number of online resources available for trainees who would like more information on HVAC 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.
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 1.2.3. It describes the operating principles and major components of HVAC systems.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with basic HVAC operating principles and components, as well as requirements and standards that relate to the systems.
3. Discuss the basic principles of heating and ventilation.
4. Identify and describe the basic principles and components of comfort air conditioning systems.

**Session Two**

Session Two covers Sections 2.0.0 through 2.2.7 and describes the types of thermostats and their uses.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with different types of thermostats and HVAC controls.
3. Explain the operating principles of thermostats.
4. Identify and discuss the different types of thermostats.
5. Explain how to install and test thermostats.

**Session Three**

Session Three is set aside for lab work needed to satisfy the module performance tasks. You can allocate lab time for these activities based on class size and available facilities. One approach would be to have some trainees complete one performance task while others work on another performance task.

1. Have the trainees demonstrate how to properly identify various types of thermostats and describe their operation and uses.
2. Have the trainees demonstrate how to properly install a conventional 24V bimetal thermostat and hook it up using the standard coding system for thermostat wiring.
3. Have the trainees demonstrate how to properly check and adjust a thermostat, including the heat anticipator setting and indicator adjustment.

Upon completion of the lab work, ask the trainees to read Sections 3.0.0–3.6.0 to prepare for the next session.
Session Outline for Module 26408-17

HVAC CONTROLS

**Session Four**

Session Four covers Sections 3.0.0 through 3.6.0 and describes HVAC control systems and devices.

1. Show the Session Four PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with modern microprocessor-based HVAC control systems.
3. Identify and describe controls used in comfort cooling systems.
4. Identify and describe furnace controls.
5. Identify and describe heat pump defrost controls.
6. Describe digital controls used in HVAC systems.
7. Analyze the operating sequences of various HVAC control systems.
8. Describe troubleshooting methods used for HVAC systems.

**Session Five**

Session Five covers Sections 4.0.0 through 4.2.4. It identifies and describes the NEC® requirements that apply to HVAC systems.

1. Show the Session Five PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the NEC® requirements for HVAC equipment.
3. Identify and discuss the NEC® requirements that apply to HVAC controls.
4. Identify and discuss the NEC® requirements that apply to HVAC equipment.

**Session Six**

Session Six 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.

1. Administer the Module Examination and any outstanding performance testing.
2. Submit the results to your Training Program Sponsor through the Registry System.
Lesson Plans for Module 26409-17

HEAT TRACING AND FREEZE PROTECTION

Module Nine (26409-17) presents heat-tracing and freeze-protection systems along with various applications and installation requirements.

Objectives

Learning Objective 1
- Describe heat-tracing applications, components, controls, and selection/installation considerations related to piping.
  a. Describe common pipeline heat-tracing applications, cables, and power distribution considerations.
  b. Describe methods of controlling and monitoring heat-tracing systems.
  c. Explain how typical heat-tracing systems operate.
  d. Explain how to select the equipment and components for a typical heat-tracing system.
  e. Explain how heat-tracing system components are installed and the related NEC® requirements.

Learning Objective 2
- Describe roof, gutter, and downspout de-icing systems and the relevant selection/installation considerations.
  a. Describe roof, gutter, and downspout de-icing systems.
  b. Explain how roof, gutter, and downspout de-icing system components are selected and installed.

Learning Objective 3
- Describe snow-melting and anti-icing systems and the relevant selection/installation considerations.
  a. Describe snow-melting and anti-icing system components.
  b. Explain how snow-melting and anti-icing system components are selected and installed.

Learning Objective 4
- Describe other electric heat-tracing and warming systems and the relevant selection/installation considerations.
  a. Describe domestic hot-water temperature maintenance systems and the relevant selection/installation considerations.
  b. Describe electric floor heating systems and the relevant selection/installation considerations.

Performance Task
Performance Task 1 (Learning Objective 1)
- Prepare and connect heat-tracing cable in a power connection box or splice box.

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


There are a number of online resources available for trainees who would like more information on heat tracing and freeze protection. 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.
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 1.5.3. It describes various heat-tracing applications.
1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with heat tracing.
3. Describe common heat-tracing applications, cables, and power distribution considerations.
5. Explain how typical heat-tracing systems operate.
6. Explain how to select the equipment and components for a typical heat-tracing system.
7. Explain how heat-tracing system components are installed and the related NEC® requirements.
8. Have the trainees prepare and connect heat-tracing cable in a power connection box or splice box. This activity corresponds to Performance Task 1.
9. Document successful Performance Task completions for each trainee on the Performance Profile Sheet and submit the results to the Training Program Sponsor.

**SESSION TWO**

Session Two covers Sections 2.0.0 through 3.2.2. It describes de-icing and snow-melting systems.
1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with de-icing systems.
3. Describe roof, gutter, and downspout de-icing systems.
4. Explain how roof, gutter, and downspout de-icing system components are selected and installed.
5. Describe snow-melting and anti-icing systems.
6. Explain how snow-melting and anti-icing system components are selected and installed.

**SESSION THREE**

Session Three covers Sections 4.0.0 through 4.2.2. It describes other electric heat-tracing and warming systems and the relevant selection/installation considerations.
1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with floor-warming systems.
3. Describe domestic hot-water temperature maintenance systems and the relevant selection/installation considerations.
4. Describe electric floor heating systems and the relevant selection/installation considerations.
Session Four 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 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.
Module Ten (26410-17) covers motor cleaning, testing, and preventive maintenance. Basic troubleshooting procedures are also presented.

### Objectives

**Learning Objective 1**
- Identify the factors that affect motor reliability and lifespan.
  - a. Identify the common causes of motor failure.
  - b. Identify motor characteristics.

**Learning Objective 2**
- Describe maintenance and troubleshooting requirements for electric motors.
  - a. Identify the tools and basic care and maintenance requirements for electric motors.
  - b. Explain the requirements for maintaining motor bearings.
  - c. Explain how to perform motor insulation testing.
  - d. Explain how to troubleshoot an electric motor.

**Learning Objective 3**
- Describe the guidelines for installing and commissioning electric motors.
  - a. Explain alignment and adjustment requirements.
  - b. Describe startup procedures.

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

### 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.
Additional Resources

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

_Millwright Level Five_, Module 15507-09, Installing Electric Motors. Alachua, FL: NCCER.

There are a number of online resources available for trainees who would like more information on motor operation and maintenance. 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.

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
- Pencils and paper
- Electrical Level Four PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Standard eye protection and work gloves for handling components
- Manufacturer's troubleshooting tables for one or more motors
- Access to one or more installed operative and faulty motors for troubleshooting and maintenance
- Vibration tester
- Infrared thermometer
- Grease gun and grease
- Magnetic V-base holder or clamp
- Base holder with a dial indicator
- Megohmmeter
- Continuity tester
- Various couplings
- Shims
- Module Review answer key
- Module Examinations

Safety Considerations

Remind the trainees to wear safety glasses and gloves when handling components, and to follow all applicable safety precautions when using meters.
Session Outline for Module 26410-17

MOTOR OPERATION AND MAINTENANCE

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. It describes the factors that affect motor reliability and lifespan.
1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the causes of motor failures.
3. Identify the common causes of motor failure.
4. Identify motor characteristics.

**SESSION TWO**
Session Two covers Sections 2.0.0 through 2.4.3. It describes maintenance and troubleshooting requirements for electric motors.
1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with motor maintenance.
3. Identify the tools and basic care and maintenance requirements for electric motors.
4. Explain the requirements for maintaining motor bearings.
5. Explain how to perform motor insulation testing.
6. Explain how to troubleshoot an electric motor.

**SESSION THREE**
Session Three covers Sections 3.0.0 through 3.2.2. It describes the guidelines for installing and commissioning electric motors.
1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with motor alignment.
3. Explain alignment and adjustment requirements.
4. Describe startup procedures.

**SESSION FOUR**
Session Four 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.

Administer the Module Examination and submit the results to your Training Program Sponsor through the Registry System.
Module Eleven identifies types of medium-voltage cable and describes how to make various splices and terminations. It also covers hi-pot testing.

**Objectives**

**Learning Objective 1**
- Describe how to splice medium-voltage cable.
  a. Identify medium-voltage power cable configurations and components.
  b. Describe a typical procedure for making a straight splice.
  c. Describe a typical procedure for making an inline tape splice.
  d. Identify various manufactured termination and splice kits.

**Learning Objective 2**
- Describe termination classes and important considerations when creating terminations.
  a. Identify termination classes.
  b. Identify stress control methods.

**Learning Objective 3**
- Define high-potential testing and explain how such testing is conducted.
  a. Identify types of hi-pot tests.
  b. Explain how to make various test connections.
  c. Describe typical procedures for conducting high-potential tests.

**Performance Task**

**Performance Task 1** (Learning Objectives 1 and 2)
- Prepare a cable and complete a splice or stress cone.

**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® presentation 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 written 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
- Pencils and paper
- Electrical Level Four PowerPoint®
- Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Standard eye protection and work gloves for handling components
- Common types of medium-voltage cable
- Inline tape splicing kits
- Cable stripping tool
- Appropriate solvent for cleaning cable
- Clean rags
- Soldering gun and solder
- Nonconductive abrasive cloth
- Various types of tape applied for primary insulation
- Manufactured termination and splice kits
- Quick inline splicing kit
- Photos of terminations/cables that have been damaged by flashover and/or tracking
- Insulators used with medium-voltage terminations
- Hi-pot tester
- Medium-voltage cable setup to demonstrate various types of hi-pot testing
- 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.

- 3M™ Premium MV Outdoor Cold Shrink Termination - Fully Integrated (QTIII) video: solutions.3m.com.
- Inline Crimp Connector Splice Installation video: solutions.3m.com.

There are a number of online resources available for trainees who would like more information on medium-voltage terminations and splices. 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 26411-17

MEDIUM-VOLTAGE TERMINATIONS/SPLICES

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 1.4.2. It describes how to splice medium-voltage cable.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with splices.
3. Identify medium-voltage power cable configurations and components.
4. Describe a typical procedure for making a straight splice.
5. Describe a typical procedure for making an inline tape splice.
6. Identify various manufactured termination and splice kits.

**SESSION TWO**

Session Two covers Sections 2.0.0 through 2.2.2. It describes termination classes and important considerations when creating terminations.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with shrink-fit splice kits.
3. Identify termination classes.
4. Identify stress control methods.
5. Have the trainees prepare a cable and complete a splice or stress cone. This activity corresponds to Performance Task 1.
6. Document successful Performance Task completions for each trainee on the Performance Profile Sheet and submit the results to the Training Program Sponsor.

**SESSION THREE**

Session Three covers Sections 3.0.0 through 3.3.2. It describes high-potential (hi-pot) testing.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with hi-pot testing.
3. Identify types of hi-pot tests.
4. Explain how to make various test connections.
5. Describe typical procedures for conducting high-potential tests.

**SESSION FOUR**

Session Four 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 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.
## Lesson Plans for Module 26412-17

### SPECIAL LOCATIONS

**Module Twelve (26412-17)** describes the NEC® requirements for selecting and installing equipment, enclosures, and devices for special locations that require unique attention. These locations include places such as places of public assembly, theaters, carnivals, agricultural and livestock facilities, marinas, swimming pools, and temporary facilities.

### Objectives

#### Learning Objective 1
- Identify and select equipment, components, and wiring methods for various special locations and applications.
  - Identify and select equipment, components, and wiring methods for places of assembly.
  - Identify and select equipment, components, and wiring methods for theaters and similar locations.
  - Identify and select equipment, components, and wiring methods for carnivals, circuses, and fairs.
  - Identify and select equipment, components, and wiring methods for agricultural buildings.
  - Identify and select equipment, components, and wiring methods for temporary installations.
  - Identify and select equipment, components, and wiring methods for wired office partitions.

#### Learning Objective 2
- Identify and select equipment, components, and wiring methods for marinas, boatyards, and bodies of water.
  - Identify and select equipment, components, and wiring methods for natural and man-made bodies of water.

#### Learning Objective 3
- Identify and select equipment, components, and wiring methods for pools, spas, tubs, and fountains.
  - Identify general wiring requirements for pools, spas, tubs, and fountains.
  - Identify and select equipment, components, and wiring methods for permanently installed pools.
  - Identify and select equipment, components, and wiring methods for storable pools.
  - Identify and select equipment, components, and wiring methods for spas, hot tubs, and therapeutic tubs.
  - Identify and select equipment, components, and wiring methods for fountains.

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

### 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 from [www.nccerirc.com](http://www.nccerirc.com). For information and updates about accessing the module examinations, visit [www.nccer.org/testing](http://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 may require trainees to visit a variety of special locations. Instructors should ensure that trainees wear the proper PPE, follow safe practices, and give due respect to any hazards that may be present when visiting job sites to observe installations.

**Classroom Equipment and Materials**
- Whiteboard and markers
- Pencils and paper
- Electrical Level Four PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations

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


There are a number of online resources available for trainees who would like more information on special locations. 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 26412-17

SPECIAL LOCATIONS

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.

SESSIONS ONE THROUGH THREE

Sessions One through Three cover Sections 1.0.0 through 1.6.0. They describe the requirements for various special locations and applications.

1. Show the Sessions One through Three PowerPoint presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with the installation of wiring in a special location.
3. Describe how to identify and select equipment, components, and wiring methods for places of assembly.
4. Describe how to identify and select equipment, components, and wiring methods for theaters and similar locations.
5. Describe how to identify and select equipment, components, and wiring methods for carnivals, circuses, and fairs.
6. Describe how to identify and select equipment, components, and wiring methods for agricultural buildings.
7. Describe how to identify and select equipment, components, and wiring methods for temporary installations.
8. Describe how to identify and select equipment, components, and wiring methods for wired office partitions.

SESSIONS SIX AND SEVEN

Sessions Six and Seven cover Sections 3.0.0 through 3.5.5. They describe the requirements for pools, spas, hot tubs, and fountains.

1. Show the Sessions Six and Seven PowerPoint presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with pools, spas, hot tubs, and fountains.
3. Identify general wiring requirements for pools, spas, tubs, and fountains.
4. Describe how to identify and select equipment, components, and wiring methods for permanently installed pools.
5. Describe how to identify and select equipment, components, and wiring methods for storable pools.
6. Describe how to identify and select equipment, components, and wiring methods for spas, hot tubs, and therapeutic tubs.
7. Describe how to identify and select equipment, components, and wiring methods for fountains.

SESSION EIGHT

Session Eight 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.

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

<table>
<thead>
<tr>
<th>Whiteboard</th>
<th>LCD projector and screen</th>
<th>Blank copies of takeoff and summary worksheets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Markers</td>
<td>Computer with Internet access during class (optional)</td>
<td>Module Review answer key</td>
</tr>
<tr>
<td>Pencils and paper</td>
<td>Blank copies of a look-ahead schedule</td>
<td>Module examinations</td>
</tr>
<tr>
<td><em>Fundamentals of Crew Leadership</em> PowerPoint® Presentation</td>
<td></td>
<td>Performance Profile Sheets</td>
</tr>
</tbody>
</table>
Additional Resources
This module presents thorough resources for task training. The following reference material is recommended for further study.


The following websites offer resources for products and training:

Aging Workforce News, [www.agingworkforcenews.com](http://www.agingworkforcenews.com)

American Society for Training and Development (ASTD), [www.astd.org](http://www.astd.org)

Architecture, Engineering, and Construction Industry (AEC), [www.aecinfo.com](http://www.aecinfo.com)

Equal Employment Opportunity Commission (EEOC), [www.eeoc.gov](http://www.eeoc.gov)

National Association of Women in Construction (NAWIC), [www.nawic.org](http://www.nawic.org)

National Census of Fatal Occupational Injuries (NCFOI), [www.bls.gov](http://www.bls.gov)

National Institute of Occupational Safety and Health (NIOSH), [www.cdc.gov/niosh](http://www.cdc.gov/niosh)

National Safety Council, [www.nsc.org](http://www.nsc.org)

Occupational Safety and Health Administration (OSHA), [www.osha.gov](http://www.osha.gov)

Society for Human Resources Management (SHRM), [www.shrm.org](http://www.shrm.org)

United States Census Bureau, [www.census.gov](http://www.census.gov)

United States Department of Labor, [www.dol.gov](http://www.dol.gov)

US Green Building Council (USGBC), [www.usgbc.org/leed](http://www.usgbc.org/leed)

Wi-Fi® is a registered trademark of the Wi-Fi Alliance, [www.wi-fi.org](http://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.