**Lesson Plans for Module 26101-17**

**ORIENTATION TO THE ELECTRICAL TRADE**

**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
- Copy of the latest edition of the National Electrical Code®
- Copy of the latest edition of NFPA 70E®, Standard for Electrical Safety in the Workplace
- Copy of the latest edition of NFPA 70®, Standard for Electrical Safety in the Workplace
- Copy of the latest edition of NFPA 70®, Standard for Electrical Safety in the Workplace

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.

Objectives

Learning Objective 1
• Identify electrical hazards and their effects.
  a. Understand the effects of electrical shock on the human body.
  b. Verify that circuits are de-energized.

Learning Objective 2
• Use PPE to reduce the risk of injury.
  a. Identify OSHA requirements for protective equipment.
  b. Select and use protective equipment.

Learning Objective 3
• Identify the standards that relate to electrical safety.
  a. Apply OSHA requirements in the workplace.
  b. Understand the purpose of NFPA 70E®.

Learning Objective 4
• Recognize the safety requirements for various hazards.
  a. Identify the safety hazards associated with ladders, scaffolds, and lift equipment.
  b. Avoid back injuries by practicing proper lifting techniques.
  c. Demonstrate basic tool safety.
  d. Identify confined space entry procedures.
  e. Work safely with dangerous materials.
  f. Select and use appropriate fall protection.

Performance Tasks

Performance Task 1
(Learning Objectives 2 and 4)
• Properly select and use PPE.

Performance Task 2
(Learning Objective 4)
• Describe the safety requirements for an instructor-supplied task, such as replacing the lights in your classroom.
  – Discuss the work to be performed and the hazards involved.
  – If a ladder is required, perform a visual inspection on the ladder and set it up properly.
  – Ensure that local emergency telephone numbers are either posted or known by you and your partner(s).
  – Plan an escape route from the location in the event of an accident.

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.
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.

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®
- 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

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

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.
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.

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**26102-17 Electrical Safety**

**Module Two**

iii
Lesson Plans for Module 26103-17

INTRODUCTION TO ELECTRICAL CIRCUITS

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.
  - 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](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.

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

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.
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**

**Learning Objective 1**
- Calculate values in resistive circuits.
  - a. Identify resistances in series.
  - b. Identify resistances in parallel.
  - d. Apply Ohm’s law to various types of circuits.

**Learning Objective 2**
- Apply Kirchhoff’s laws to various types of circuits.
  - a. Use Kirchhoff’s current law.
  - b. Use Kirchhoff’s voltage law.

**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.
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.

**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

**Classroom Equipment and Materials**

- Computer
- Internet access during class (optional)
- Sample schematics
- Module Review answer key
- Module Examinations

**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
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.

**SESSION ONE**

Session One covers Sections 1.0.0–1.3.1, and discusses resistive circuit calculations.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with resistive circuit calculations.
3. Explain how to identify resistances in series.
4. Explain how to identify resistances in parallel.
5. Demonstrate how to simplify series-parallel circuits.

**SESSION TWO**

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.

**SESSION THREE**

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.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to encourage trainees to familiarize themselves with Kirchhoff’s laws.
3. Explain how to use Kirchhoff’s current law.
4. Explain how to use Kirchhoff’s voltage law.
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.
6. 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 26105-17

INTRODUCTION TO THE NATIONAL ELECTRICAL CODE®

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.
**Safety Considerations**

There are no safety considerations for this module.

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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*®
- Module Review answer key
- Module Examinations
- 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 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.
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.
## Safety Considerations
This module requires trainees to work with various types of boxes. 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 knockouts have sharp edges and gloves/safety goggles must be worn at all times.

## 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.

### Classroom Equipment and Materials
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<td>Whiteboard and markers</td>
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<td>Pencils and paper</td>
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<td><em>Electrical Level One PowerPoint®</em> Presentation Slides</td>
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<td>DVD player</td>
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<td>LCD projector and screen</td>
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<td>Computer</td>
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<td>Internet access during class (optional)</td>
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<tr>
<td>Copy of the latest edition of the <em>National Electrical Code®</em></td>
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<td>Module Review answer key</td>
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<td>Module Examinations</td>
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<td>Performance Profile Sheets</td>
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### Equipment and Materials for Laboratories and Performance Testing
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<td>Safety glasses/goggles</td>
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<td>Hard hats</td>
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<td>Electrician’s hand tools</td>
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<td>Conduit caps</td>
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<td>Examples of different types of metallic and nonmetallic outlet boxes,</td>
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<td>device covers, and extension rings</td>
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<td>Examples of pull and junction boxes</td>
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<td>Wire nuts</td>
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<td>NM cable</td>
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### Equipment and Materials for Laboratories and Performance Testing

#### 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

#### 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
(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 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.

**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.
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
Appropriate personal protective equipment
Sample sections and fittings for the following types of conduit:
  - EMT
  - RMC
  - Plastic-coated RMC
  - Aluminum
  - Rigid black
  - IMC
  - EB and DB RNC
  - LFNC
  - Flexible metal
Various conduit couplings
Combination couplings
Offset nipples
Type C, Type L, Type T, and Type X conduit bodies
Various types of bushings
Insulated bushings
Threaded waterproof hubs
Seal fittings and packing material
Liquid sealing compound
Various straps
Standoff support
Framing channel

Copy of the latest edition of the National Electrical Code®
OSHA Electrical Safety Guidelines (pocket edition)
Powder-actuated tool operator’s certification training program
Calculator
Module Review answer key
Module Examinations
Performance Profile Sheets

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)

<table>
<thead>
<tr>
<th>Assorted mechanical anchors and assorted anchor fastening tools, including:</th>
<th>Access to job site where trainees can observe a variety of wireway components, including:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wedge</td>
<td>Connectors</td>
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<tr>
<td>Stud</td>
<td>End plates</td>
</tr>
<tr>
<td>Sleeve</td>
<td>Closing plates</td>
</tr>
<tr>
<td>One-piece</td>
<td>Tee fittings</td>
</tr>
<tr>
<td>Hammer-driven</td>
<td>Crosses</td>
</tr>
<tr>
<td>Drop-in</td>
<td>Elbows</td>
</tr>
<tr>
<td>Expansion shields</td>
<td>Nipples</td>
</tr>
<tr>
<td>Screw (fiber, lead, plastic)</td>
<td>Slip fittings</td>
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<tr>
<td>Self-drilling</td>
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<tr>
<td>Toggle bolts</td>
<td></td>
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<td>Sleeve-type</td>
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<tr>
<td>Wallboard</td>
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<td>Metal drive-in</td>
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<tr>
<td>Metal boxes</td>
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<tr>
<td>Nonmetallic boxes</td>
<td></td>
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<tr>
<td>Bushings and locknuts</td>
<td></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 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.
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 Outline for Module 26108-17

RACEWAYS AND FITTINGS

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.

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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®*
- 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
  - 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.
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 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 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 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.ncceirc.com. For information and updates about accessing the Module Examinations, visit www.ncce.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 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.
Lesson Plans for Module 26111-17

RESIDENTIAL ELECTRICAL SERVICES

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.
  a. Calculate the electric service load.
  b. Apply demand factors.
  c. Calculate appliance loads.
  d. Size the load center.

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

Learning Objective 3
• Install service-entrance equipment.
  a. Identify the service drop location.
  b. Select the panelboard location.

Learning Objective 4
• Identify wiring methods for various types of residences.
  a. Select and install cable systems.
  b. Select and install raceways.

Learning Objective 5
• Lay out branch circuits and size outlet boxes.
  a. Complete the branch circuit layout for power.
  b. Complete the branch circuit layout for lighting.
  c. Install outlet boxes.

Learning Objective 6
• Select and install various wiring devices.
  a. Select and install receptacles.
  b. Select and install switches.
  c. 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.
Session Outline for Module 26111-17
RESIDENTIAL ELECTRICAL SERVICES

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.
RESIDENTIAL ELECTRICAL SERVICES

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 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 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.
6. 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 26112-17

ELECTRICAL TEST EQUIPMENT

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.
  a. Identify the applications of a voltmeter.
  b. Identify the applications of an ohmmeter.
  c. Identify the applications of an ammeter.
  d. Identify the applications of a multimeter.
  e. Identify the applications of other meters.

Learning Objective 2
- Select a meter with the correct category rating for an application.
  a. 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
NFPA 70®, National Electrical Code® and NEC® are registered trademarks of the National Fire Protection Association, Quincy, MA.

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. 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.

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

*ABCs of Multimeter Safety.* 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.

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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®
- 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
  - Ohmmeter
  - Clamp-on ammeter
  - Multimeter
  - Megohmmeter
  - Motor and phase rotation testers
  - Continuity tester

**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.
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.