MODULE OVERVIEW
This module introduces the trainees to the safety rules and regulations for E & I technicians, including the necessary precautions for avoiding the various hazards that exist on the job.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Industrial Maintenance E & I Technician Level One.

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

1. Demonstrate safe working procedures in an industrial environment.
2. Explain the purposes of OSHA and NFPA 70E and how they promote safety on the job.
3. Recognize electrical/energy hazards and describe how to avoid or minimize them in the workplace.
4. Explain safety issues concerning lockout/tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection systems.
5. Recognize and apply safe working practices.

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

1. Perform a visual inspection and an air test on rubber gloves.
2. Develop a task plan and deliver a task briefing:
   • Discuss the work to be performed and the hazards involved.
   • Locate the closest phone to the work site and ensure that the local emergency telephone numbers are either posted at the phone or known by you and your partner(s).
   • Plan an escape route from the location in the event of an accident.
3. Identify and describe the electrical hazards in your work site.

MATERIALS AND EQUIPMENT LIST

- Overhead projector and screen
- Transparencies
- Blank acetate sheets
- Transparency pens
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and scratch paper
- Appropriate personal protective equipment
- Copy of the latest edition of the National Electrical Code®
- OSHA Electrical Safety Guidelines (pocket guide)
- NFPA 70E
- GFCI device
- Access to eye wash station
- Company safety manual
- Company lockout/tagout procedures
- Lockout/tagout devices and labels
- Solvent MSDS
- Various types of personal protective and safety equipment, including:
  - Rubber gloves
  - Insulating blankets
  - Hot sticks
  - Fuse pullers
  - Shorting probes
  - Safety glasses
  - Face shields
- Step ladders
- Straight ladders
- Fall arrest system
- Safety harnesses
- TV/DVD/VCR player (optional)
- Safety videos (optional)
- Trade Terms Quiz*
- Module Examinations**
- Performance Profile Sheets**

* Located in the back of this module
**Located in the Test Booklet
SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

ADDITIONAL RESOURCES

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


TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 12½ hours are suggested to cover Industrial Safety for E & I Technicians. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Electrical Shock; Reducing the Risk of Electrical Shock</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Electrical Shock</td>
<td></td>
</tr>
<tr>
<td>1. The Effect of Current</td>
<td></td>
</tr>
<tr>
<td>a. Body Resistance</td>
<td></td>
</tr>
<tr>
<td>b. Burns</td>
<td></td>
</tr>
<tr>
<td>C. Reducing the Risk of Electrical Shock</td>
<td></td>
</tr>
<tr>
<td>1. Protective Equipment</td>
<td></td>
</tr>
<tr>
<td>2. Verifying Circuits That are De-Energized</td>
<td></td>
</tr>
<tr>
<td>3. Other Precautions</td>
<td></td>
</tr>
<tr>
<td>4. NFPA 70E</td>
<td></td>
</tr>
<tr>
<td>D. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice performing a visual inspection and an air test on rubber gloves. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Energy Control</strong></td>
<td></td>
</tr>
<tr>
<td>A. Energy Control</td>
<td></td>
</tr>
<tr>
<td>1. Lockout/Tagout</td>
<td></td>
</tr>
<tr>
<td>2. Lockout/Tagout Procedures</td>
<td></td>
</tr>
<tr>
<td>3. Safeguards</td>
<td></td>
</tr>
</tbody>
</table>
Session III. Ladders and Scaffolds; Lifts, Hoists, and Cranes; Lifting; Basic Tool Safety; Confined Space Entry Procedures
A. Ladders and Scaffolds
B. Lifts, Hoists, and Cranes
C. Lifting
D. Basic Tool Safety
E. Confined Space Entry Procedures

Session IV. First Aid; Solvents and Toxic Vapors; Asbestos; Batteries; PCBs and Vapor Lamps; Fall Protection
A. First Aid
B. Solvents and Toxic Vapors
C. Asbestos
D. Batteries
E. PCBs and Vapor Lamps
F. Fall Protection
G. Laboratory
Have the trainees practice developing a task plan and delivering a task briefing, including discussing the work to be performed and the hazards involved; locating the closest phone to the work site and ensuring that the local emergency phone numbers are either posted at the phone or are known by the trainees and their partners; and planning an escape route from the location in the event of an accident. This laboratory corresponds to Performance Task 2.
H. Laboratory
Have the trainees practice identifying and describing the electrical hazards at their work site. This laboratory corresponds to Performance Task 3.

Session V. Review and Testing
A. Review
B. Module Examination
   1. Trainees must score 70 percent or higher to receive recognition from NCCER.
   2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from the NCCER.
   2. Record the training results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW

This module provides an introduction to the National Electrical Code®.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Industrial Maintenance E & I Technician Level One; and Industrial Maintenance E & I Technician Level Two, Module 40201-08.

OBJECTIVES

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

1. Explain the purpose and history of the National Electrical Code® (NEC®).
2. Describe the layout of the NEC®.
3. Explain how to navigate the NEC®.
4. Describe the purpose of the National Electrical Manufacturers Association (NEMA) and the National Fire Protection Association (NFPA).
5. Explain the role of nationally recognized testing laboratories.

PERFORMANCE TASKS

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

1. Find the definition of the term feeder in the NEC®.
2. Look up the NEC® requirements that you would need to follow if you were installing a receptacle in a cooling tower.
3. Find the minimum wire bending space required for two 1/0 AWG conductors installed in a junction box or cabinet and entering opposite the terminal.

MATERIALS AND EQUIPMENT LIST

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

Copy of the latest edition of the National Electrical Code®
Sample of a labeled device
Trade Terms Quiz*
Module Examination**
Performance Profile Sheets**

* Located in the back of this module
**Located in the Test Booklet

SAFETY CONSIDERATIONS

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

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


TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 5 hours are suggested to cover Introduction to the National Electrical Code®. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction to the NEC®; Purpose and History of the NEC®; The Layout of the NEC®; Navigating the NEC®; Other Organizations</strong></td>
<td></td>
</tr>
</tbody>
</table>
Session II. Review and Testing

A. Review

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

C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from the NCCER.
   2. Record the training results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW
This module introduces trainees to basic electrical theory and troubleshooting, using circuit calculations involving the application of Ohm’s and Kirchhoff’s laws.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Industrial Maintenance E & I Technician Level One; and Industrial Maintenance E & I Technician Level Two, Modules 40201-08 and 40202-08.

OBJECTIVES
Upon completion of this module, the trainee will be able to do the following:
1. Define voltage and identify the ways in which it can be produced.
2. Explain the difference between conductors and insulators.
3. Define the units of measurement that are used to measure the properties of electricity.
4. Identify the meters used to measure voltage, current, and resistance.
5. Explain the basic characteristics of series and parallel circuits.
6. Use Kirchhoff’s current law to calculate the total and unknown currents in parallel and series-parallel circuits.
7. Use Kirchhoff’s voltage law to calculate voltage drops in series, parallel, and series-parallel circuits.
8. Use the formula for Ohm’s law to calculate voltage, current, and resistance.

PERFORMANCE TASKS
Under the supervision of the instructor, the trainee should be able to do the following:
1. Use the formula for Ohm’s law to calculate voltage, current, and resistance.
2. Given different resistors, identify the correct resistance value and tolerance using the color code.
3. Draw basic voltmeter and ohmmeter circuits and explain how they operate.
4. Use the power formula to calculate the amount of power used by a circuit.
5. Use a variation of the power formula to calculate the main current a resistor can carry based on the resistor’s value and power rating.
6. Calculate the total resistance for selected series, parallel, and series-parallel circuits.
7. Use Kirchhoff’s current law to calculate the total and unknown currents in parallel and series-parallel circuits.
8. Use Kirchhoff’s voltage law to calculate voltage drops in series, parallel, and series-parallel circuits.

MATERIALS AND EQUIPMENT LIST

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead projector and screen</td>
<td>Located in the back of this module</td>
</tr>
<tr>
<td>Transparencies</td>
<td></td>
</tr>
<tr>
<td>Blank acetate sheets</td>
<td></td>
</tr>
<tr>
<td>Transparency pens</td>
<td></td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td></td>
</tr>
<tr>
<td>Markers/chalk</td>
<td></td>
</tr>
<tr>
<td>Pencils and scratch paper</td>
<td></td>
</tr>
<tr>
<td>Multimeters, ammeters, voltmeters, and ohmmeters</td>
<td></td>
</tr>
<tr>
<td>Copy of the latest edition of the National Electrical Code®</td>
<td>Located in the Test Booklet</td>
</tr>
<tr>
<td>Wire-wound and carbon composition electronic resistors</td>
<td></td>
</tr>
<tr>
<td>Trade Terms Quiz*</td>
<td></td>
</tr>
<tr>
<td>Module Examinations**</td>
<td></td>
</tr>
<tr>
<td>Performance Profile Sheets**</td>
<td></td>
</tr>
</tbody>
</table>
SAFETY CONSIDERATIONS

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

ADDITIONAL RESOURCES

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


TEACHING TIME FOR THIS MODULE

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Atomic Theory; Electrical Power Generation and Distribution; Electric Charge and Current</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Atomic Theory</td>
<td></td>
</tr>
<tr>
<td>1. The Atom</td>
<td></td>
</tr>
<tr>
<td>2. Conductors and Insulators</td>
<td></td>
</tr>
<tr>
<td>3. Magnetism</td>
<td></td>
</tr>
<tr>
<td>C. Electrical Power Generation and Distribution</td>
<td></td>
</tr>
<tr>
<td>D. Electric Charge and Current</td>
<td></td>
</tr>
<tr>
<td>1. Current Flow</td>
<td></td>
</tr>
<tr>
<td>2. Voltage</td>
<td></td>
</tr>
<tr>
<td>3. Resistance</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Ohm’s Law; Schematic Representation of Circuit Elements; Resistors</strong></td>
<td></td>
</tr>
<tr>
<td>A. Ohm’s Law</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice using the formula for Ohm’s law to calculate voltage, current, and resistance. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>C. Schematic Representation of Circuit Elements</td>
<td></td>
</tr>
<tr>
<td>D. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice drawing basic voltmeter and ohmmeter circuits and explain how they operate. This laboratory corresponds to Performance Task 3.</td>
<td></td>
</tr>
<tr>
<td>E. Resistors</td>
<td></td>
</tr>
<tr>
<td>F. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice, given different resistors, identifying the correct resistance value and tolerance using the color code. This laboratory corresponds to Performance Task 2.</td>
<td></td>
</tr>
</tbody>
</table>
Session III. Electrical Circuits; Electrical Measuring Instruments; Electrical Power

A. Electrical Circuits
   1. Series Circuits
   2. Parallel Circuits
   3. Series-Parallel Circuits

B. Electrical Measuring Instruments
   1. Measuring Current
   2. Measuring Voltage
   3. Measuring Resistance
   4. Voltage Testers

C. Electrical Power
   1. Power Equation
   2. Power Rating of Resistors

D. Laboratory
   Have the trainees practice using the power formula to calculate the amount of power used by a circuit. This laboratory corresponds to Performance Task 4.

E. Laboratory
   Have the trainees practice using a variation of the power formula to calculate the main current a resistor can carry based on the resistor’s value and power rating. This laboratory corresponds to Performance Task 5.

Sessions IV and V. DC Circuit Calculations

A. DC Circuit Calculations
   1. Resistances in Series
   2. Resistances in Parallel
   3. Series-Parallel Circuits

B. Laboratory
   Have the trainees practice calculating the total resistance for selected series, parallel, and series-parallel circuits. This laboratory corresponds to Performance Task 6.

C. Applying Ohm’s Law

D. Kirchhoff’s Laws

E. Laboratory
   Have the trainees practice using Kirchhoff’s current law to calculate the total and unknown currents in parallel and series-parallel circuits. This laboratory corresponds to Performance Task 7.

F. Laboratory
   Have the trainees practice using Kirchhoff’s voltage law to calculate voltage drops in series, parallel, and series-parallel circuits. This laboratory corresponds to Performance Task 8.

Session VI. Review and Testing

A. Review

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

C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from the NCCER.
   2. Record the training results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW
This module introduces the principles of alternating current.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Industrial Maintenance E & I Technician Level One; and Industrial Maintenance E & I Technician Level Two, Modules 40201-08 through 40203-08.

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

PERFORMANCE TASKS
Under the supervision of the instructor, the trainee should be able to do the following:
1. Given the parameters of an inductive circuit with a low power factor, calculate the true and apparent power and identify methods that could be used to improve the efficiency of the circuit.
2. Solve for two values of a power triangle provided by your instructor.

MATERIALS AND EQUIPMENT LIST
Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper

Appropriate personal protective equipment
Scientific calculator or trigonometric tables
Examples of capacitors
Trade Terms Quiz*
Module Examinations**
Performance Profile Sheets**

* Located in the back of this module
**Located in the Test Booklet
SAFETY CONSIDERATIONS
Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly.

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


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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Sine Wave Generation; Sine Wave Terminology</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Sine Wave Generation</td>
<td></td>
</tr>
<tr>
<td>C. Sine Wave Terminology</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. AC Phase Relationships; Nonsinusoidal Waveforms</strong></td>
<td></td>
</tr>
<tr>
<td>A. AC Phase Relationships</td>
<td></td>
</tr>
<tr>
<td>B. Nonsinusoidal Waveforms</td>
<td></td>
</tr>
<tr>
<td><strong>Session III. Resistance in AC Circuits; Inductance in AC Circuits</strong></td>
<td></td>
</tr>
<tr>
<td>A. Resistance in AC Circuits</td>
<td></td>
</tr>
<tr>
<td>B. Inductance in AC Circuits</td>
<td></td>
</tr>
<tr>
<td><strong>Session IV. Capacitance</strong></td>
<td></td>
</tr>
<tr>
<td>A. Capacitance</td>
<td></td>
</tr>
<tr>
<td>1. Factors Affecting Capacitance</td>
<td></td>
</tr>
<tr>
<td>2. Calculating Equivalent Capacitance</td>
<td></td>
</tr>
<tr>
<td>3. Capacitor Specifications</td>
<td></td>
</tr>
<tr>
<td>4. Voltage and Current in a Capacitive AC Circuit</td>
<td></td>
</tr>
<tr>
<td>5. Capacitive Resistance</td>
<td></td>
</tr>
<tr>
<td><strong>Sessions V and VI. LC and RLC Circuits; Power in AC Circuits</strong></td>
<td></td>
</tr>
<tr>
<td>A. LC and RLC Circuits</td>
<td></td>
</tr>
<tr>
<td>B. Power in AC Circuits</td>
<td></td>
</tr>
<tr>
<td>C. Laboratory</td>
<td>Given the parameters of an inductive circuit with a low power factor, have the trainees practice calculating the true and apparent power and identify methods that could be used to improve the efficiency of the circuit. This laboratory corresponds to Performance Task 1.</td>
</tr>
<tr>
<td>D. Laboratory</td>
<td>Have the trainees practice solving for two values of a power triangle provided by the instructor. This laboratory corresponds to Performance Task 2.</td>
</tr>
</tbody>
</table>


Session VII. Transformers
A. Transformers
   1. Transformer Construction
   2. Operating Characteristics
   3. Turns and Voltage Ratio
   4. Types of Transformers

Session VIII. Review and Testing
A. Review
B. Module Examination
   1. Trainees must score 70 percent or higher to receive recognition from NCCER.
   2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
   2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW
This module covers the use of various test instruments for testing and performing troubleshooting on electrical equipment.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Industrial Maintenance E & I Technician Level One; and Industrial Maintenance E & I Technician Level Two, Modules 40201-08 through 40204-08.

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

1. Identify and explain the purposes of test instruments commonly used to test and troubleshoot E & I equipment.
2. Explain how to read and convert from one scale to another using the above test equipment.
3. Explain the importance of proper meter polarity.
4. Define frequency and explain the use of a frequency meter.
5. Explain the difference between digital and analog meters.

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

1. Under instructor supervision, measure the voltage in your classroom (hot to neutral and neutral to ground).
2. Under instructor supervision, use an ohmmeter to measure the values of various resistors.
3. Use a continuity tester to verify whether a lamp is burned out.
4. Using a pressure source, measure pressure with the appropriate device.
5. Use a field communicator.
6. Use a manometer or a deadweight tester.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Copy of the latest edition of the National Electrical Code®
Samples of the following test equipment:
  Voltmeter
  Ohmmeter
  Ammeter
  Voltage tester
  Volt-ohm-milliammeter (VOM)
  Megohmmeter
  Motor rotation tester
  Phase rotation tester
  Handheld HART® communicator
  Fluke® 725 (or other) multifunction process calibrator
  Fluke® 744 documenting process calibrator
  Fluke® 789 ProcessMeter™
  Various process control test and calibration meters
  Manometers (U-tube, well, inclined, and electronic)
  Deadweight tester
  Module Examinations*
  Performance Profile Sheets*

* Located in the Test Booklet
SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

ADDITIONAL RESOURCES

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

- ABCs of Multimeter Safety, Everett, WA: Fluke Corporation.
- ABCs of DMMs Multimeter Features and Functions Explained, Everett, WA: Fluke Corporation.
- Clamp Meter ABCs, Everett, WA: Fluke Corporation.
- Power Quality Analyzer Uses for Electricians, Everett, WA: Fluke Corporation.

TEACHING TIME FOR THIS MODULE

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session I. Introduction; Electrical Meters</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Electrical Meters</td>
<td></td>
</tr>
<tr>
<td>1. Voltmeter</td>
<td></td>
</tr>
<tr>
<td>2. Ohmmeter</td>
<td></td>
</tr>
<tr>
<td>3. Ammeter</td>
<td></td>
</tr>
<tr>
<td>4. Multimeter</td>
<td></td>
</tr>
<tr>
<td>5. Megohmmeter</td>
<td></td>
</tr>
<tr>
<td>6. Motor and Phase Rotation Testers</td>
<td></td>
</tr>
<tr>
<td>7. Recording Instruments</td>
<td></td>
</tr>
<tr>
<td>C. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Under instructor supervision, have the trainees practice measuring the voltage in your classroom (hot to neutral and neutral to ground). This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>D. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Under instructor supervision, have the trainees practice using an ohmmeter to measure the values of various resistors. This laboratory corresponds to Performance Task 2.</td>
<td></td>
</tr>
</tbody>
</table>
Session II. Electrical Category Ratings; Electrical Safety; Calibration

A. Electrical Category Ratings
B. Electrical Safety
C. Calibration
D. Laboratory
   Have the trainees practice using a continuity tester to verify whether a lamp is burned out. This laboratory corresponds to Performance Task 3.
E. Laboratory
   Using a pressure source, have the trainees practice measuring pressure with the appropriate device. This laboratory corresponds to Performance Task 4.

Session III. Instrumentation Test Equipment

A. Instrumentation Test Equipment
   1. HART® Communication and Communicator
   2. Process Calibrators
   3. Fluke 789 ProcessMeter™
   4. Manometer
   5. Deadweight Tester
B. Laboratory
   Have the trainees practice using a field communicator. This laboratory corresponds to Performance Task 5.
C. Laboratory
   Have the trainees practice using a manometer or a deadweight tester. This laboratory corresponds to Performance Task 6.

Session IV. Review and Testing

A. Review
B. Module Examination
   1. Trainees must score 70 percent or higher to receive recognition from NCCER.
   2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from the NCCER.
   2. Record the training results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
 MODULE OVERVIEW

This module introduces devices used to measure flow, pressure, level, and temperature in instrument and control systems.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Industrial Maintenance E & I Technician Level One; and Industrial Maintenance E & I Technician Level Two, Modules 40201-08 through 40205-08.

OBJECTIVES

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

1. Identify and describe methods of flow measurement.
2. Identify and describe methods of pressure measurement.
3. Identify and describe methods of temperature measurement.
4. Identify and describe methods of level measurement.

PERFORMANCE TASKS

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

MATERIALS AND EQUIPMENT LIST

- Overhead projector and screen
- Transparencies
- Blank acetate sheets
- Transparency pens
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and scratch paper
- Appropriate personal protective equipment
- Samples of pressure measurement devices, including:
  - Various types of manometers
  - Bellows-type pressure sensors
  - Various types of Bourdon tubes
  - Pneumatic and electronic transmitters
- Samples of pressure element protection devices, including:
  - Isolation diaphragms
  - Snubbers
- Samples of flow measurement devices, including:
  - Orifice plates
  - Flow nozzles
  - Venturi tubes
  - Pitot tubes
  - Target flowmeters
  - Electromagnetic flowmeters
  - Turbine flowmeters
  - Various types of vortex flowmeters
  - Variable area flowmeters (rotameters)
  - Coriolis meters
- Samples of temperature measurement devices, including:
  - Fluid thermometers
  - Bimetallic thermometers
  - Various types of thermocouples
  - Resistance temperature detectors (RTDs)
  - Thermistors
  - Non-contact thermometers (pyrometers)
- Samples of level measurement devices, including:
  - Dipsticks and lead lines
  - Sight glasses (gauge glasses)
  - Float and cable arrangements
  - Displacers
  - Hydrostatic head devices
  - Bubbler systems
  - Magnetic float devices
  - Conductance devices
  - Various types of capacitance devices
  - Ultrasonic level measurement system
  - Electric load cells
- Trade Terms Quiz*
- Module Examinations**

* Located in the back of this module
**Located in the Test Booklet
SAFETY CONSIDERATIONS

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

ADDITIONAL RESOURCES

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


TEACHING TIME FOR THIS MODULE

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Pressure</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Pressure</td>
<td></td>
</tr>
<tr>
<td>1. Units of Pressure Measurement</td>
<td></td>
</tr>
<tr>
<td>2. Pressure Measurement Devices</td>
<td></td>
</tr>
<tr>
<td>3. Conditions That Damage Pressure Elements</td>
<td></td>
</tr>
<tr>
<td>4. Pressure Element Protection Devices</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Flow</strong></td>
<td></td>
</tr>
<tr>
<td>A. Flow</td>
<td></td>
</tr>
<tr>
<td>1. Flow Measurement Units</td>
<td></td>
</tr>
<tr>
<td>2. Differential Pressure and Flow Relationship</td>
<td></td>
</tr>
<tr>
<td>3. Differential Pressure Flow Devices</td>
<td></td>
</tr>
<tr>
<td>4. Other Types of Flow Measurement Devices</td>
<td></td>
</tr>
<tr>
<td>5. Flow Device Installation Considerations</td>
<td></td>
</tr>
<tr>
<td><strong>Session III. Temperature</strong></td>
<td></td>
</tr>
<tr>
<td>A. Temperature</td>
<td></td>
</tr>
<tr>
<td>1. Temperature Scales</td>
<td></td>
</tr>
<tr>
<td>2. Temperature Measurement Devices</td>
<td></td>
</tr>
</tbody>
</table>
Sessions IV and V. Level

A. Level
   1. Level Measurement and Pressure
   2. Direct Level Measurement Devices
   3. Indirect Level Measurement Devices
   4. Special Level Measurement Instruments

B. Laboratory
   Have the trainees practice measuring pressure, flow, temperature, and level using various methods.

Session VI. Review and Testing

A. Review

B. Module Examination
   1. Trainees must score 70 percent or higher to receive recognition from NCCER.
   2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW
This module covers the metric and English systems in depth, along with conversions from one system to the other. It also covers the calculation of squares and square roots.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Industrial Maintenance E & I Technician Level One; and Industrial Maintenance E & I Technician Level Two, Modules 40201-08 through 40206-08.

OBJECTIVES
Upon completion of this module, the trainee will be able to do the following:
1. Identify different units of pressure measurement.
2. Convert measured values in the English system, using common conversion factor tables, to equivalent SI values.
3. Perform the basic mathematical operations necessary in instrumentation.
4. Square numbers and find the square root of numbers.
5. Perform the mathematical conversions necessary for instrumentation measurements.

PERFORMANCE TASKS
Under the supervision of the instructor, the trainee should be able to do the following:
1. Find the point where Fahrenheit equals Celsius.
2. Do three temperature conversions.
3. Calculate differential pressure.
4. Calculate the volume of a vessel.

MATERIALS AND EQUIPMENT LIST
Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk

Pencils and scratch paper
Appropriate personal protective equipment
Calculators
Trade Terms Quiz*
Module Examinations**
Performance Profile Sheets**

* Located in the back of this module
**Located in the Test Booklet

SAFETY CONSIDERATIONS
Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly.
**ADDITIONAL RESOURCES**

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


**TEACHING TIME FOR THIS MODULE**

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Metric Measurements</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Metric Measurements</td>
<td></td>
</tr>
<tr>
<td>1. Converting Lengths</td>
<td></td>
</tr>
<tr>
<td>2. Converting Areas</td>
<td></td>
</tr>
<tr>
<td>3. Converting Volumes</td>
<td></td>
</tr>
<tr>
<td>4. Wet Volume Measurements</td>
<td></td>
</tr>
<tr>
<td>C. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice calculating the volume of a vessel. This laboratory corresponds to Performance Task 4.</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Metric Measurements (continued)</strong></td>
<td></td>
</tr>
<tr>
<td>A. Mass versus Weight</td>
<td></td>
</tr>
<tr>
<td>B. Pressure</td>
<td></td>
</tr>
<tr>
<td>1. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice calculating differential pressure. This laboratory corresponds to Performance Task 3.</td>
<td></td>
</tr>
<tr>
<td>C. Temperature</td>
<td></td>
</tr>
<tr>
<td>1. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice finding the point where Fahrenheit equals Celsius. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>D. Flow</td>
<td></td>
</tr>
<tr>
<td><strong>Session III. Handheld Calculators; Instrumentation Applications</strong></td>
<td></td>
</tr>
<tr>
<td>A. Handheld Calculators and Instrumentation Applications</td>
<td></td>
</tr>
<tr>
<td>1. Squares and Square Roots</td>
<td></td>
</tr>
<tr>
<td>2. Auxiliary Functions</td>
<td></td>
</tr>
</tbody>
</table>
Sessions IV and V. Technical Applications

A. Technical Applications
   1. Converting to a Metric Rule Dipstick
   2. Sight Glass Level Measurement
   3. Conductance Probe Settings
   4. Open Tank Measurement Conversions
   5. Pressurized Tank Measurement Conversions
   6. Temperature Measurement Conversion

C. Laboratory
   Have the trainees practice doing three temperature conversions. This laboratory corresponds to Performance Task 2.

Session VI. Review and Testing

A. Review

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

C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER.
   2. Record the training results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW
This module introduces trainees to the methods and procedures used in cutting, hand bending, reaming, and threading conduit.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Industrial Maintenance E & I Technician Level One; and Industrial Maintenance E & I Technician Level Two, Modules 40201-08 through 40207-08.

OBJECTIVES
Upon completion of this module, the trainee will be able to do the following:
1. Identify the methods for hand bending and installing conduit.
2. Calculate conduit bends.
3. Make 90-degree bends, back-to-back bends, offsets, kicks, and saddle bends using a hand bender.
4. Cut, ream, and thread conduit.

PERFORMANCE TASKS
Under the supervision of the instructor, the trainee should be able to do the following:
1. Make 90-degree bends, back-to-back bends, offsets, kicks, and saddle bends using a hand bender.
2. Cut, ream, and thread conduit.

MATERIALS AND EQUIPMENT LIST
- Overhead projector and screen
- Transparencies
- Blank acetate sheets
- Transparency pens
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and scratch paper
- Appropriate personal protective equipment
- Copy of the latest edition of the National Electrical Code®
- OSHA Electrical Safety Guidelines (pocket edition)
- Hand bender and manufacturer’s instructions
- Various pieces of conduit
- Hickey
- Manufacturers’ gain tables
- No. 10 or No. 12 solid wire
- Tape measure
- Calculator
- Hacksaw
- Pipe vise
- Pipe cutter
- Reamer
- Cutting oil
- Shop towels
- Hand-operated threader
- Sandbox or drip pan
- Torpedo level
- PVC pieces
- PVC cements
- Trade Terms Quiz*
- Module Examinations**
- Performance Profile Sheets**

* Located in the back of this module
**Located in the Test Booklet
SAFETY CONSIDERATIONS

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

ADDITIONAL RESOURCES

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


TEACHING TIME FOR THIS MODULE

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Hand Bending</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Hand Bending Equipment</td>
<td></td>
</tr>
<tr>
<td>1. Geometry Required to Make a Bend</td>
<td></td>
</tr>
<tr>
<td>2. Making a 90-Degree Bend</td>
<td></td>
</tr>
<tr>
<td>C. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice making 90-degree bends. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>D. Gain</td>
<td></td>
</tr>
<tr>
<td>E. Back-to-Back 90-Degree Bends</td>
<td></td>
</tr>
<tr>
<td>F. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice making back-to-back bends. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session II. Offsets; Saddle Bends</strong></td>
<td></td>
</tr>
<tr>
<td>A. Making an Offset</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice making kicks. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>C. Parallel Offsets</td>
<td></td>
</tr>
<tr>
<td>D. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice making offset bends. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>E. Saddle Bends</td>
<td></td>
</tr>
<tr>
<td>F. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice making saddle bends. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>G. Four-Bend Saddles</td>
<td></td>
</tr>
</tbody>
</table>
Session III. Cutting, Reaming, and Threading Conduit; Cutting and Joining PVC Conduit

A. Cutting, Reaming, and Threading Conduit
   1. Hacksaw Method of Cutting Conduit
   2. Pipe Cutter Method
   3. Reaming Conduit
   4. Threading Conduit

B. Laboratory
   Have the trainees practice cutting, reaming, and threading conduit. This laboratory corresponds to Performance Task 2.

C. Cutting and Joining PVC Conduit

Session IV. Review and Testing

A. Review

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

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

This module introduces the trainees to materials, tools, and methods used to measure, cut, bend, and join tubing.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Industrial Maintenance E & I Technician Level One, and Industrial Maintenance E & I Technician Level Two, Modules 40201-08 through 40208-08.

OBJECTIVES

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

1. Identify the different kinds of tubing and describe the properties and common uses for each kind.
2. Explain the purpose for tubing standards and specifications.
3. Describe the proper handling and storage of tubing.
4. Cut tubing using the proper tools, cutting methods, and safety procedures.
5. Bend tubing using the proper tools, bending methods, and safety procedures.
6. Identify and select proper tubing fittings for selected instrumentation applications.
7. Flare tubing using the proper tools, flaring methods, and safety procedures.
8. Make and remake a compression fitting.

PERFORMANCE TASKS

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

1. Bend copper tubing at 45-degree and 90-degree angles using a compression-type bender.
2. Cut and deburr copper tubing using a hacksaw or tubing cutter.
3. Cut and deburr stainless steel tubing.
4. Install a flare fitting on a section of copper tubing.
5. Properly make up an instrument tubing connection with a compression fitting, then loosen and retighten it.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Outside or inside vernier caliper
Rule
Samples of various types of tubing, including:
  - Copper
  - Steel
  - Stainless steel
  - Aluminum
Monel®
Inconel®
Hastelloy®
Poly (plastic)
PVC (PE, polypropylene, Teflon®, Tygon®, and nylon)
Samples of various tools for cutting, including:
  - Handheld, internal, and soft tubing cutters
  - Hacksaw
  - Bandsaw
  - Ratchet shears
  - Pipe cutters
  - Tubing shear
  - Reamer, spiral reamer, and other deburring tools
  - Sharp knife
  - Sandpaper
  - Flare nut wrench
SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

ADDITIONAL RESOURCES

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


TEACHING TIME FOR THIS MODULE

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session I. Introduction; Sizes and Types of Tubing</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Sizes and Types of Tubing</td>
<td></td>
</tr>
<tr>
<td>1. General Sizing Measurements for Tubing</td>
<td></td>
</tr>
<tr>
<td>2. Tubing Materials</td>
<td></td>
</tr>
<tr>
<td>3. Tubing Standards and Specifications</td>
<td></td>
</tr>
</tbody>
</table>
Session II. Proper and Safe Methods for Storing and Handling Tubing:
Cutting Tubing
A. Proper and Safe Methods for Storing Tubing
B. Proper and Safe Methods for Handling Tubing
C. Cutting Tubing
   1. Types and Sizes of Tubing Cutters
   2. Cutting Tubing with a Tube Cutter
   3. Cutting Tubing with a Hacksaw
   4. Cutting Tubing with a Bandsaw
   5. Cutting Poly Tubing
   6. Deburring Tubing
D. Laboratory
   Have the trainees practice cutting and deburring copper tubing using a
   hacksaw or tubing cutter. This laboratory corresponds to Performance Task 2.
E. Laboratory
   Have the trainees practice cutting and deburring stainless steel tubing. This
   laboratory corresponds to Performance Task 3.

Session III. Bending Tubing
A. Bending Tubing
   1. Standard Tubing Bends
   2. Tubing Bending Methods
   3. Types of Tubing Benders
B. Laboratory
   Have the trainees practice bending copper tubing at 45-degree and 90-degree
   angles using a compression-type bender. This laboratory corresponds to
   Performance Task 1.

Sessions IV and V. Tubing Fittings; Flaring Tubing
A. Flare Fittings
B. Compression Fittings
   1. Laboratory
      Have the trainees practice properly making up an instrument tubing
      connection with a compression fitting, then loosen and re-tighten it.
      This laboratory corresponds to Performance Task 5.
C. Socket-Welded Fittings
D. Butt-Weld Fittings
E. Types of Tubing Fittings
F. Flaring Tubing
   1. Laboratory
      Have the trainees practice installing a flare on a section of copper tubing.
      This laboratory corresponds to Performance Task 4.

Session VI. Review and Testing
A. Review
B. Module Examination
   1. Trainees must score 70 percent or higher to receive recognition from NCCER.
   2. Record the testing results on Craft Training Report Form 200, and submit the
      results to the Training Program Sponsor.
C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive
      recognition from the NCCER.
   2. Record the training results on Craft Training Report Form 200, and submit the
      results to the Training Program Sponsor.
Clean, Purge, and Test Tubing and Piping Systems
Annotated Instructor’s Guide

MODULE OVERVIEW
This module introduces the trainees to the procedures for safely and effectively cleaning, purging, and testing piping, tubing, and hoses.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Industrial Maintenance E & I Technician Level One; and Industrial Maintenance E & I Technician Level Two, Modules 40201-08 through 40209-08.

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

1. Identify cleaning, flushing, and purging procedures.
2. Describe the general cleaning and purging requirements for piping and tubing.
3. Perform the appropriate cleaning and flushing methods until required cleanliness has been achieved.
4. Describe and select pressure and leak testing methods for piping/tubing systems.
5. Identify precautions associated with testing piping/tubing systems.
6. Perform pressure leak tests per approved procedures.
7. Prepare required test documentation.

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

1. Set up and perform a pressure leak test.
2. Inspect the system to verify there is no leakage.
3. Perform a blowdown/purge.
4. Document the test results and restore the system to be service-ready.

MATERIALS AND EQUIPMENT LIST
- Overhead projector and screen
- Transparencies
- Blank acetate sheets
- Transparency pens
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and scratch paper
- Appropriate personal protective equipment
- Bubbler leak tester
- Liquid bubble test fluid
- Access to a system to perform blowdown/purge and pressure leak tests
- Trade Terms Quiz*
- Module Examinations**
- Performance Profile Sheets**

* Located in the back of this module
**Located in the Test Booklet

SAFETY CONSIDERATIONS
Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.
ADDITIONAL RESOURCES

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


TEACHING TIME FOR THIS MODULE

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Cleaning and Purging; Pressure and Leak Testing</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Cleaning and Purging</td>
<td></td>
</tr>
<tr>
<td>1. General Cleaning Requirements for Tubing and Piping</td>
<td></td>
</tr>
<tr>
<td>2. Cleaning, Flushing, and Purging Methods</td>
<td></td>
</tr>
<tr>
<td>3. Applicable Records and Documentation</td>
<td></td>
</tr>
<tr>
<td>C. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice performing a blowdown/purge. This laboratory corresponds to Performance Task 3.</td>
<td></td>
</tr>
<tr>
<td>D. Pressure and Leak Testing</td>
<td></td>
</tr>
<tr>
<td>1. Selection Criteria for Testing Methods</td>
<td></td>
</tr>
<tr>
<td>2. Description of Testing Methods</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Pressure and Leak Testing (continued)</strong></td>
<td></td>
</tr>
<tr>
<td>A. Pressure and Leak Testing</td>
<td></td>
</tr>
<tr>
<td>1. Testing Precautions</td>
<td></td>
</tr>
<tr>
<td>2. General Test Procedures</td>
<td></td>
</tr>
<tr>
<td>3. Test Documentation</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice setting up and performing a pressure leak test. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>C. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice inspecting the system to verify there is no leakage. This laboratory corresponds to Performance Task 2.</td>
<td></td>
</tr>
<tr>
<td>D. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice documenting the test results and restoring the system to be service-ready. This laboratory corresponds to Performance Task 4.</td>
<td></td>
</tr>
</tbody>
</table>
Session III. Review and Testing

A. Review

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

C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from the NCCER.
   2. Record the training results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW
This module introduces drawings for instrumentation systems and explains the symbols and other elements found in these drawings.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Industrial Maintenance E & I Technician Level One; and Industrial Maintenance E & I Technician Level Two, Modules 40201-08 through 40210-08.

OBJECTIVES
Upon completion of this module, the trainee will be able to do the following:
1. Identify and describe standard Instrument Society of America (ISA) instrument symbols and abbreviations.
2. Read and interpret instrument indexes.
3. Read and interpret general instrument specifications.
4. Read and interpret general notes and details included on instrument drawings and documents.
5. Read and interpret installation detail drawings.
6. Read and interpret location drawings.

PERFORMANCE TASKS
Under the supervision of the instructor, the trainee should be able to do the following:
1. Locate and identify drawing elements.

MATERIALS AND EQUIPMENT LIST

<table>
<thead>
<tr>
<th>Materials and Equipment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead projector and screen</td>
<td>Appropriate personal protective equipment</td>
</tr>
<tr>
<td>Transparencies</td>
<td>ISA Standard S5.1, Instrumentation Symbols and Identification</td>
</tr>
<tr>
<td>Blank acetate sheets</td>
<td>Samples of instrument indexes</td>
</tr>
<tr>
<td>Transparency pens</td>
<td>Trade Terms Quiz*</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td>Module Examinations**</td>
</tr>
<tr>
<td>Markers/chalk</td>
<td>Performance Profile Sheets**</td>
</tr>
<tr>
<td>Pencils and scratch paper</td>
<td>* Located in the back of this module</td>
</tr>
<tr>
<td></td>
<td>**Located in the Test Booklet</td>
</tr>
</tbody>
</table>

SAFETY CONSIDERATIONS
Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.
ADDITIONAL RESOURCES

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

- ISA Standard S5.1, Instrumentation Symbols and Identification
- ISA Standard S5.2, Binary Logic Diagrams for Process Operations
- ISA Standard S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems
- ISA Standard S5.4, Instrument Loop Diagrams
- ISA Standard S5.5, Graphical Symbols for Process Displays
- ISA Standard S51.1, Process Instrumentation Terminology

TIME FOR THIS MODULE

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Instrument Symbols and Identification</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Instrument Symbols and Identification</td>
<td></td>
</tr>
<tr>
<td>1. Instrument Symbols</td>
<td></td>
</tr>
<tr>
<td>2. Instrument Tag Numbers and Identification Abbreviations</td>
<td></td>
</tr>
<tr>
<td>3. Graphic or Pictorial Instrument Symbols</td>
<td></td>
</tr>
<tr>
<td>4. Line Symbols</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Instrument Index</strong></td>
<td></td>
</tr>
<tr>
<td>A. Instrument Index</td>
<td></td>
</tr>
<tr>
<td><strong>Session III. General Instrument Specifications</strong></td>
<td></td>
</tr>
<tr>
<td>A. General Instrument Specifications</td>
<td></td>
</tr>
<tr>
<td><strong>Session IV. General Notes and Details; Installation Detail Drawings</strong></td>
<td></td>
</tr>
<tr>
<td>A. General Notes and Details</td>
<td></td>
</tr>
<tr>
<td>B. Installation Detail Drawings</td>
<td></td>
</tr>
<tr>
<td><strong>Session V. Location Drawings; Control Loops</strong></td>
<td></td>
</tr>
<tr>
<td>A. Location Drawings</td>
<td></td>
</tr>
<tr>
<td>B. Control Loops</td>
<td></td>
</tr>
<tr>
<td>C. Laboratory</td>
<td>Have the trainees practice locating and identifying drawing elements. This laboratory corresponds to Performance Task 1.</td>
</tr>
</tbody>
</table>
Session VI. Review and Testing

A. Review

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

C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from the NCCER.
   2. Record the training results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW
This module provides information for selecting and installing conductors and cables, including how to pull conductors through conduit runs.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Industrial Maintenance E & I Technician Level One; and Industrial Maintenance E & I Technician Level Two, Modules 40201-08 through 40211-08.

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

1. From the cable markings, describe the insulation and jacket material, conductor size and type, number of conductors, temperature rating, voltage rating, and permitted uses.
2. Determine the allowable ampacity of a conductor for a given application.
3. Identify the NEC® requirements for color coding of conductors.
4. Install conductors in a raceway system.

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

1. Install conductors in a raceway system.

MATERIALS AND EQUIPMENT LIST

| Overhead projector and screen | Overhead projector and screen |
| Transparencies | Transparencies |
| Blank acetate sheets | Blank acetate sheets |
| Transparency pens | Transparency pens |
| Whiteboard/chalkboard | Whiteboard/chalkboard |
| Markers/chalk | Markers/chalk |
| Pencils and scratch paper | Pencils and scratch paper |
| Appropriate personal protective equipment | Appropriate personal protective equipment |
| Copy of the latest edition of the National Electrical Code® | Copy of the latest edition of the National Electrical Code® |

| Aluminum conductors | Aluminum conductors |
| Copper conductors | Copper conductors |
| Samples of thermoplastic insulation materials, including: | Samples of thermoplastic insulation materials, including: |
| Polyvinyl chloride (PVC) | Polyvinyl chloride (PVC) |
| Polyethylene (PE) | Polyethylene (PE) |
| Cross-linked polyethylene (XLP) | Cross-linked polyethylene (XLP) |
| Nylon | Nylon |
| Teflon® | Teflon® |
| Color-coded wires | Color-coded wires |

Samples of various types of cable, including:

- NM
- NMC
- UF
- NMS
- MV
- MC
- AC
- FC
- FCC
- TC
- SE
- USE

Shields for instrumentation control wiring

- Shield drain
- Jackets
- Fish tape
- Rodder
- Wire grips
- Module Examinations*
- Performance Profile Sheets*

* Located in the Test Booklet
SAFETY CONSIDERATIONS
Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

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


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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session I. Introduction; Conductors and Insulation</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Conductors and Insulation</td>
<td></td>
</tr>
<tr>
<td>1. Wire Size</td>
<td></td>
</tr>
<tr>
<td>2. Ampacity</td>
<td></td>
</tr>
<tr>
<td>3. Conductor Material</td>
<td></td>
</tr>
<tr>
<td>4. Conductor Insulation</td>
<td></td>
</tr>
<tr>
<td>Session II. Conductors and Insulation (continued)</td>
<td></td>
</tr>
<tr>
<td>A. Conductors and Insulation</td>
<td></td>
</tr>
<tr>
<td>1. Fixture Wires</td>
<td></td>
</tr>
<tr>
<td>2. Cables</td>
<td></td>
</tr>
<tr>
<td>3. Instrumentation Control Wiring</td>
<td></td>
</tr>
<tr>
<td>Session III. Installing Conductors in Conduit Systems</td>
<td></td>
</tr>
<tr>
<td>A. Installing Conductors in Conduit Systems</td>
<td></td>
</tr>
<tr>
<td>1. Fish Tape</td>
<td></td>
</tr>
<tr>
<td>2. Wire Grips</td>
<td></td>
</tr>
<tr>
<td>3. Pull Lines</td>
<td></td>
</tr>
<tr>
<td>4. Safety Precautions</td>
<td></td>
</tr>
<tr>
<td>5. Pulling Equipment</td>
<td></td>
</tr>
<tr>
<td>6. Feeding Conductors into Conduit</td>
<td></td>
</tr>
<tr>
<td>7. Conductor Lubrication</td>
<td></td>
</tr>
<tr>
<td>8. Conductor Termination</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td>Have the trainees practice installing conductors in a raceway system. This laboratory corresponds to Performance Task 1.</td>
</tr>
</tbody>
</table>
Session IV. Review and Testing

A. Review

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

C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from the NCCER.
   2. Record the training results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
Conductor Terminations and Splices
Annotated Instructor’s Guide

MODULE OVERVIEW
This module introduces the methods and procedures for making conductor terminations and splices.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Industrial Maintenance E & I Technician Level One; and Industrial Maintenance E & I Technician Level Two, Modules 40201-08 through 40212-08.

OBJECTIVES
Upon completion of this module, the trainee will be able to do the following:
1. Describe how to make a sound conductor termination.
2. Prepare cable ends for terminations and splices and connect the ends using lugs or connectors.
3. Train cable at termination points.
4. Describe the National Electrical Code® (NEC®) requirements for making cable terminations and splices.
5. Demonstrate crimping techniques.
6. Select the proper lug or connector for the job.

PERFORMANCE TASKS
Under the supervision of the instructor, the trainee should be able to do the following:
1. Terminate conductors using selected crimp-type and mechanical-type terminals and connectors.
2. Terminate conductors on a terminal strip.
3. Insulate selected types of wire splices and/or install a motor connection kit.

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

* Located in the back of this module
**Located in the Test Booklet
SAFETY CONSIDERATIONS

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

ADDITIONAL RESOURCES

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


TEACHING TIME FOR THIS MODULE

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Stripping and Cleaning Conductors;</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Wire Connections Under 600 Volts</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Stripping and Cleaning Conductors</td>
<td></td>
</tr>
<tr>
<td>C. Wire Connections under 600V</td>
<td></td>
</tr>
<tr>
<td>D. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice stripping insulation from the end of a cable.</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Control and Signal Cable; Low-Voltage Connectors and Terminals; Guidelines for Installing Connectors</strong></td>
<td></td>
</tr>
<tr>
<td>A. Control and Signal Cable</td>
<td></td>
</tr>
<tr>
<td>B. Low-Voltage Connectors and Terminals</td>
<td></td>
</tr>
<tr>
<td>C. Guidelines for Installing Connectors</td>
<td></td>
</tr>
<tr>
<td>D. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice terminating conductors on a terminal strip.</td>
<td></td>
</tr>
<tr>
<td>This laboratory corresponds to Performance Task 2.</td>
<td></td>
</tr>
<tr>
<td><strong>Session III. Bending Cable and Training Conductors; NEC® Termination Requirements; Taping Electrical Joints; Motor Connection Kits</strong></td>
<td></td>
</tr>
<tr>
<td>A. Bending Cable and Training Conductors</td>
<td></td>
</tr>
<tr>
<td>B. NEC® Termination Requirements</td>
<td></td>
</tr>
<tr>
<td>C. Taping Electrical Joints</td>
<td></td>
</tr>
<tr>
<td>D. Motor Connection Kits</td>
<td></td>
</tr>
<tr>
<td>E. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice terminating conductors using selected crimp-type and mechanical-type terminals and connectors. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>F. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have the trainees practice insulating selected types of wire splices and/or install a motor connection kit. This laboratory corresponds to Performance Task 3.</td>
<td></td>
</tr>
</tbody>
</table>
Session IV. Review and Testing

A. Review

B. Module Examination

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

C. Performance Testing

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