Introduction to the Trade
Annotated Instructor’s Guide

Module Overview

This module provides an overview of the alarm and telecommunications industries. It introduces trainees to guidelines for professional conduct and their responsibilities to themselves, their employers, their customers, and their fellow workers. Apprenticeship program standards are also briefly covered.

Prerequisites

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

Objectives

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

1. State the purpose of the electronic systems industry and describe the role of an electronic systems technician in the industry.
2. State the role played by industry associations and be able to identify key associations.
3. State the rules for professional and ethical conduct.
4. Describe the importance of codes and standards and explain how they affect the work of the electronic systems technician.
5. Recognize some of the tools used in the industry.
6. Complete job-related forms.

Performance Task

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

1. Fill out job-related forms.

Materials and Equipment List

- Markers/chalk
- Pencils and scratch paper
- Whiteboard/chalkboard
- EST 1 PowerPoint® Presentation Slides
- Multimedia projector and screen
- Desktop or laptop computer
- Appropriate personal protective equipment
- Copies of the latest edition of the National Electrical Code®
- Examples of building codes and cabling standards
- Copies of licensing examination test questions (if applicable in your state)
- A sample company policy or standard
- Copies of the following types of documents:
  - Contracts
  - Work statements
  - Bills of material
  - As-built diagrams
- Time sheets
- Job sheets
- Floor plans
- Cable stripping and termination tools:
  - Coaxial cable crimp tool and replacement die
  - Coaxial cable stripper
  - Bix tool blade
  - Punch-down tool
  - Coax compression tool
  - Soldering iron
  - Wire stripper/crimper
- Examples of test instruments:
  - Multimeter
  - Telephone test set
  - LAN cable tester
  - Tone generation/amplifier probe kit
  - Module Examinations*
  - Performance Profile Sheets*

*Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize basic electrical system safety. Review hand and power tool safety. Before working in a laboratory or touring a site, review safety equipment and emergency procedures for the area; include fire prevention, fire alarms and extinguishers, and emergency exits.

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 2½ hours are suggested to cover Introduction to the Trade. 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; Elements of Professionalism; Review and Testing</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
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<tr>
<td>B. Certification and Licensing</td>
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<tr>
<td>C. Your Responsibilities as an Employee</td>
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<tr>
<td>D. Industry Standards and Building Codes</td>
<td>1. National Electrical Code®</td>
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<td>2. National Fire Protection Association</td>
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<td>3. National Building Codes</td>
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<td>4. Other Standards</td>
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<td>E. Documentation and Paperwork</td>
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<tr>
<td>F. Laboratory</td>
<td>Trainees practice filling out a time sheet and a job sheet. This laboratory corresponds to Performance Task 1.</td>
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<td>G. Your Training Program</td>
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<td>H. Tools of the Trade</td>
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<tr>
<td>I. Module Review</td>
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<tr>
<td>J. Module Examination</td>
<td>1. Trainees must score 70 percent or higher to receive recognition from NCCER.</td>
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<td></td>
<td>2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.</td>
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<tr>
<td>K. Performance Testing</td>
<td>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.</td>
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<td>2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.</td>
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Module Overview

This module provides an overview of the materials and techniques commonly used for constructing and finishing wood or masonry structures. Included are descriptions of the tools and procedures used to install fasteners and anchors in wood, masonry, and drywall. Power tools commonly used for running cable are also described.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Electronic Systems Technician Level One, Module 33101-10.

Objectives

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

1. Describe the composition and uses of the common types of residential building materials.
2. Identify the major structural components of a residential building.
3. State the major steps in the construction of a frame residence.
4. Explain common terms used in residential construction.
5. Describe how cable is run within a building.
6. Select the appropriate drill bits and bore openings in lumber and masonry.
7. Cut plywood with a jig saw or reciprocating saw.
8. Select and install appropriate fasteners and anchors in the following:
   - Wood
   - Masonry
   - Drywall

Performance Tasks

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

1. Select the appropriate drill bits and bore openings in lumber and masonry.
2. Cut plywood with a jig saw or reciprocating saw.
3. Select and install appropriate fasteners and anchors in the following:
   - Wood
   - Masonry
   - Drywall

Materials and Equipment List

Pencils and scratch paper
Whiteboard/chalkboard
Markers/chalk
EST 1 PowerPoint® Presentation Slides
Multimedia projector and screen
Desktop or laptop computer
Appropriate personal protective equipment
Rulers or measuring tape
Samples of typical construction materials:
   - Dimension lumber
   - Plywood and building boards
   - Engineered wood products
   - Concrete blocks
   - Building brick
   - Components of a wood framing system or an illustration of a framing system
   - Operator’s manuals for selected power tools
   - Power screwdriver
   - Drill
   - Selection of drill bits and hole saws
   - Jig saw and blades
   - Reciprocating saw and blades
   - Power cutout tool
Circle cutter
Scrap pieces of lumber, gypsum wallboard, and plywood for drilling and cutting
Hammers
Selection of fasteners:
   Nails
   Screws
   Hollow-wall anchors

Tie wraps
Cable clips
Rivet gun and rivets
Nail bar
Stud finder
Module Examinations*
Performance Profile Sheets*

*Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires the trainees to use power tools for cutting and drilling. Brief trainees on shop safety procedures and point out fire extinguishers, first aid stations, and other emergency equipment. Review basic electrical safety and power tool safety. Emphasize the use of personal protective equipment. This module may require that the trainees visit job sites. Ensure that trainees are briefed on job-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.

*Informational Transport Systems Installation Methods Manual (ITSIMM), 5th ed. Tampa, FL: BICSI.*

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 Wood and Masonry Construction Methods. 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 and Building Materials</td>
<td></td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Building Materials</td>
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<tr>
<td>1. Gypsum Board</td>
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<td>2. Masonry Materials</td>
<td></td>
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<tr>
<td>Session II. Wood Frame Construction</td>
<td></td>
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<tr>
<td>A. Sills</td>
<td></td>
</tr>
<tr>
<td>B. Floor Construction</td>
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<tr>
<td>C. Wall Construction</td>
<td></td>
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<tr>
<td>D. Ceiling Construction</td>
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<tr>
<td>E. Roof Construction</td>
<td></td>
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<tr>
<td>F. Plank-and-Beam Framing</td>
<td></td>
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<tr>
<td>G. Wall Framing in Masonry</td>
<td></td>
</tr>
<tr>
<td>H. Walls Separating Occupancies</td>
<td></td>
</tr>
</tbody>
</table>
Session III. Fasteners and Anchors
   A. Screws
   B. Nonthreaded Fasteners
   C. Screw Anchors
   D. Hollow-Wall Anchors

Session IV. Tools
   A. Guidelines for Using All Power Tools
   B. Drilling Tools
   C. Cutting Tools
   D. Stud Finders

Session V. Laboratories; Review and Testing
   A. Laboratory
      Have trainees practice selecting the correct drill bits and boring openings in lumber and masonry. This laboratory corresponds to Performance Task 1.
   B. Laboratory
      Have trainees practice cutting plywood with a jig saw or reciprocating saw. This laboratory corresponds to Performance Task 2.
   C. Laboratory
      Have trainees practice installing fasteners and anchors in wood, masonry, and drywall. This laboratory corresponds to Performance Task 3.
   D. Module Review
   E. Module Examination
      1. Trainees must score 70 percent or higher to receive recognition from NCCER.
      2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.
   F. Performance Testing
      1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from the NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
      2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.
Module Overview

This module presents information on the materials and techniques used to construct commercial buildings. It covers fasteners, anchors, and tools that ESTs use to run cable in concrete and steel structures. Fire- and sound-rated walls and suspended ceilings are also discussed.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Electronic Systems Technician Level One, Modules 33101-10 and 33102-10.

Objectives

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

1. Describe the composition and uses of the common types of commercial building materials.
2. Describe the common methods of commercial construction.
3. Explain common terms used in commercial construction.
4. Identify various types of suspended ceilings.
5. Identify the tools used to make openings in concrete and steel.
6. Select the appropriate drill bits and bore openings in concrete and steel.
7. Select and install appropriate fasteners and anchors in the following:
   • Concrete
   • Steel

Performance Tasks

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

1. Select the appropriate drill bits and bore openings in concrete and steel.
2. Select and install appropriate fasteners and anchors in the following:
   • Concrete
   • Steel

Materials and Equipment List

<table>
<thead>
<tr>
<th>Pencils and scratch paper</th>
<th>Operator’s manuals for selected power tools</th>
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<tbody>
<tr>
<td>Whiteboard/chalkboard</td>
<td>Torque wrench</td>
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<tr>
<td>Markers/chalk</td>
<td>Drill</td>
</tr>
<tr>
<td>EST 1 PowerPoint® Presentation Slides</td>
<td>Rotary hammer</td>
</tr>
<tr>
<td>Multimedia projector and screen</td>
<td>Selection of concrete fasteners</td>
</tr>
<tr>
<td>Desktop or laptop computer</td>
<td>Selection of screws, nuts, and washers</td>
</tr>
<tr>
<td>Appropriate personal protective equipment</td>
<td>Module Examinations*</td>
</tr>
<tr>
<td>Samples of the following construction materials:</td>
<td>Performance Profile Sheets*</td>
</tr>
<tr>
<td>Metal studs</td>
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<tr>
<td>Mechanical firestop devices</td>
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<td>Firestopping materials</td>
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*Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.
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 use power tools for cutting and drilling. Brief all trainees on shop safety procedures and point out the location of fire extinguishers, first aid stations, and other emergency equipment. Review basic electrical safety and power tool safety. Emphasize the use of personal protective equipment. 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 *Concrete and Steel Construction Methods*. 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>
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<tbody>
<tr>
<td>Session I. Introduction; Building Materials</td>
<td></td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Building Materials</td>
<td></td>
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<tr>
<td>1. Concrete</td>
<td></td>
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<tr>
<td>2. Metal</td>
<td></td>
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<tr>
<td>Session II. Commercial Construction Methods; Fire-Rated and Sound-Rated Walls</td>
<td></td>
</tr>
<tr>
<td>A. Commercial Construction Methods</td>
<td></td>
</tr>
<tr>
<td>1. Floors</td>
<td></td>
</tr>
<tr>
<td>2. Exterior Walls</td>
<td></td>
</tr>
<tr>
<td>3. Interior Walls and Partitions</td>
<td></td>
</tr>
<tr>
<td>4. Roof Structure</td>
<td></td>
</tr>
<tr>
<td>5. Ceilings</td>
<td></td>
</tr>
<tr>
<td>B. Fire-Rated and Sound-Rated Walls</td>
<td></td>
</tr>
<tr>
<td>1. Fire-Rated Construction</td>
<td></td>
</tr>
<tr>
<td>2. Sound-Isolation Construction</td>
<td></td>
</tr>
<tr>
<td>Session III. Fasteners and Anchors; Special Tools</td>
<td></td>
</tr>
<tr>
<td>A. Fasteners and Anchors</td>
<td></td>
</tr>
<tr>
<td>1. Threaded Fasteners</td>
<td></td>
</tr>
<tr>
<td>2. Bolts and Screws</td>
<td></td>
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<tr>
<td>3. Nuts and Washers</td>
<td></td>
</tr>
<tr>
<td>4. Installing Fasteners</td>
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<tr>
<td>5. Eye Bolts</td>
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</tbody>
</table>
6. Hammer-Driven Pins and Studs
7. Mechanical and Self-Drilling Anchors
8. Guidelines for Drilling Anchor Holes in Hardened Concrete and Masonry
9. Epoxy Anchoring Systems

B. Special Tools
   1. Hammer Drills and Rotary Hammers
   2. Core Drills
   3. Metal Stud Punches
   4. Powder-Actuated Tools and Fasteners

Session IV. Laboratories
   A. Laboratory
      Have trainees practice selecting the appropriate drill bits and boring openings in concrete and steel. This laboratory corresponds to Performance Task 1.

   B. Laboratory
      Have trainees practice selecting and installing appropriate fasteners and anchors in concrete and steel. This laboratory corresponds to Performance Task 2.

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

This module introduces the many types of conduits and wireways used in low-voltage applications, along with their supporting hardware. An overview of telecommunications cable pathways from the source to the destination, including maintenance holes, ducts, equipment rooms, and telecommunications rooms, is also provided.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Electronic Systems Technician Level One, Modules 33101-10 through 33103-10.

Objectives

Upon completion of this module, the trainee will be able to do the following:
1. Describe various types of cable trays and raceways.
2. Identify and select various types and sizes of raceways and fittings.
3. Identify and select various types and sizes of cable trays.
4. Identify various methods used to install raceways.
5. Demonstrate knowledge of NEC® raceway requirements.
6. Describe procedures for installing raceways and boxes on various surfaces.
7. Make a conduit-to-box connection.
8. Select cable support hardware for various applications.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:
1. Make a conduit-to-box connection.
2. Select cable support hardware for various applications.

Materials and Equipment List

Pencils and scratch paper
Whiteboard/chalkboard
Markers/chalk
EST 1 PowerPoint® Presentation Slides
Multimedia projector and screen
Desktop or laptop computer
Appropriate personal protective equipment
Copies of the latest edition of the National Electrical Code®
Sections of various types of conduit:
- ENT
- Inner duct
- EMT
- RMC
- Plastic-coated RMC
- Aluminum conduit
- IMC
- EB and DB PVC
- LFNC
- Flexible metal conduit
- An assortment of conduit couplings and connectors
- Type C, Type L, Type T, and Type X conduit bodies
- Threaded waterproof hub
- Insulating bushings
- Offset nipples
- Metal boxes
- PVC box
- Concrete outlet boxes and extension rings
- Bushings and locknuts
- Sealing fittings
- Selection of low-voltage boxes, mud rings, and face plates
- An assortment of straps and ties
- Beam clamps
- J-hooks
- Bridle rings
- D-rings and half D-rings
- Mushroom posts
- Standoff support
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize basic electrical system safety and hand and power tool safety. Before working in a laboratory or touring a site, review safety equipment and emergency procedures for the area including fire prevention, fire alarms and extinguishers, and emergency exits.

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 session 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 2 1⁄2 hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 12 1⁄2 hours are suggested to cover Pathways and Spaces. 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>
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<tbody>
<tr>
<td>Session I. Introduction; Raceways; Conduit</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
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<td>B. Raceways</td>
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<tr>
<td>C. Conduit</td>
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<tr>
<td>1. Conduit as a Ground Path</td>
<td></td>
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<tr>
<td>2. Electrical Nonmetallic Tubing</td>
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<td>3. Inner Duct</td>
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<td>4. Electrical Metallic Tubing</td>
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<td>5. Rigid Metal Conduit</td>
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<td>6. Plastic-Coated RMC</td>
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<td>7. Aluminum Conduit</td>
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<td>8. Black Enamel Steel Conduit</td>
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<td>9. Intermediate Metal Conduit</td>
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<td>10. Nonmetallic Conduit</td>
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<tr>
<td>11. Flexible Metal Conduit</td>
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</tbody>
</table>
Session II. Fittings; Bushings; Supports
   A. Metal Conduit Fittings
      1. Couplings
      2. Conduit Bodies
      3. Insulating Bushings
      4. Offset Nipples
   B. Bushings and Locknuts
   C. Sealing Fittings
   D. Cable and Raceway Supports
      1. Straps
      2. Standoff Supports
      3. Electrical Framing Channels
      4. Beam Clamps
      5. Cable Supports

Session III. Raceways; Cable Trays; Storing and Handling Raceways
   A. Surface Metal and Nonmetallic Raceways
      1. Pole Systems
      2. Underfloor Systems
      3. Cellular Metal Floor Raceways
      4. Cellular Concrete Floor Raceways
   B. Cable Trays
      1. Cable Tray Fittings
      2. Cable Tray Supports
   C. Storing Raceways
   D. Handling Raceways
   E. Laboratory
      Have trainees practice selecting the correct cable support hardware for various applications. This laboratory corresponds to Performance Task 2.

Session IV. Underground Systems; Boxes; Making a Conduit-to-Box Connection
   A. Underground Systems
      1. Duct Materials
      2. Plastic Conduit
      3. Monolithic Concrete Duct
      4. Controlled Environment Vaults
      5. Pedestals and Cabinets
   B. Boxes
      1. Metal Boxes
      2. Nonmetallic Boxes
      3. Low-Voltage Boxes, Mud Rings, Mounting Plates, and Faceplates
   C. Making a Conduit-to-Box Connection
   D. Laboratory
      Have trainees practice making a conduit-to-box connection.
      This laboratory corresponds to Performance Task 1.
Session V. Construction Procedures; Overview of Cable Distribution; Review and Testing

A. Construction Procedures
   1. Masonry and Concrete Flush-Mount Construction
   2. Metal Stud Environment
   3. Wood-Frame Environment
   4. Steel Environment
   5. Suspended Ceilings

B. Overview of Cable Distribution
   1. Pathways
   2. Spaces

C. Module Review

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

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

This module expands on the information presented in the Core Curriculum module, *Introduction to Construction Math*. Emphasis is placed on the metric system, including conversion between corresponding English and metric units. Also covered are the use of scientific notation, powers and roots, and the basic concepts of algebra, geometry, and right-angle trigonometry.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum* and *Electronic Systems Technician Level One*, Modules 33101-10 through 33104-10.

Objectives

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

1. Identify similar units of measurement in both the English and metric systems and know which units are larger.
2. Convert measured values in the English system to equivalent metric values and vice versa.
3. Express numbers as powers of ten.
4. Determine the powers and roots of numbers.
5. Solve basic algebraic equations.
6. Recognize various geometric figures, and use the correct formulas to calculate their areas and volumes.
7. Use the Pythagorean theorem and trigonometry to make calculations involving right triangles.
8. Convert decimal feet to feet and inches and vice versa.

Performance Tasks

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

Materials and Equipment List

| Pencils and scratch paper | Metric and standard rulers |
| Whiteboard/chalkboard | A small scale and weights (metric and English units) |
| Markers/chalk | Thermometers (Fahrenheit and Celsius) |
| EST 1 PowerPoint® Presentation Slides | Ice water |
| Multimedia projector and screen | Module Examinations* |
| Desktop or laptop computer | |
| Scientific calculators (recommended) Casio fx260 TI-36X | |

*Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.*
Safety Considerations

Ensure that 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 12½ hours are suggested to cover Craft-Related Mathematics. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td><strong>Session I. Introduction; Conversion; the Metric System</strong></td>
<td></td>
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<tr>
<td>A. Introduction</td>
<td></td>
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<tr>
<td>B. Converting Decimal Feet to Feet and Inches</td>
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<tr>
<td>C. Laboratory</td>
<td>Have trainees practice converting dimensions given in decimal feet to feet and inches and vice versa. (Worksheet 1)</td>
</tr>
<tr>
<td>D. The Metric System</td>
<td></td>
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<tr>
<td>E. Laboratory</td>
<td>Have trainees practice converting values in English system units to equivalent metric system values and vice versa. (Worksheet 2)</td>
</tr>
<tr>
<td><strong>Session II. Scientific and Engineering Notation</strong></td>
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</tr>
<tr>
<td>A. Scientific Notation</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td>Have trainees practice expressing numbers as powers of ten. (Worksheet 3)</td>
</tr>
<tr>
<td>C. Engineering Notation</td>
<td></td>
</tr>
<tr>
<td><strong>Session III. Decibels; Logarithms; Powers and Roots</strong></td>
<td></td>
</tr>
<tr>
<td>A. Decibels</td>
<td></td>
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<tr>
<td>B. Logarithms</td>
<td></td>
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<tr>
<td>C. Powers and Roots</td>
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<tr>
<td>D. Laboratory</td>
<td>Have trainees practice calculating the powers and roots of numbers. (Worksheet 4)</td>
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<tr>
<td><strong>Session IV. Introduction to Algebra and Geometry</strong></td>
<td></td>
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<tr>
<td>A. Definition of Terms</td>
<td></td>
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<tr>
<td>B. Sequence of Operations</td>
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<tr>
<td>C. Solving Algebraic Equations</td>
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<tr>
<td>D. Laboratory</td>
<td>Have trainees practice solving basic algebraic equations for an unknown. (Worksheet 5)</td>
</tr>
</tbody>
</table>
E. Introduction to Geometry
F. Laboratory
   Have trainees practice recognizing various geometric figures. (Worksheet 6)

Session V. Right Triangles; Review and Testing
A. Working with Right Triangles
B. Laboratory
   Have trainees practice calculating unknown angles and side lengths of right triangles using the Pythagorean theorem and trigonometry. (Worksheet 7)
C. Module Review
D. Module Examination
   1. Trainees must score 70 percent or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.
Module Overview

This module provides an introduction to conduit bending and installation. It also covers the techniques for using hand-operated and step conduit benders, as well as cutting, reaming, and threading conduit.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Electronic Systems Technician Level One, Modules 33101-10 through 33105-10.

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. Determine 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. Given a piece of EMT, complete the following using a hand bender, hacksaw, and reaming tool. No couplings are allowed, and there should be no kinks in the pipe.
   - Offset
   - Saddle
   - 90-degree stub-up
   - Back-to-back
2. Cut and ream EMT conduit.
3. Cut and join PVC conduit.

Materials and Equipment List

- Pencils and scratch paper
- Whiteboard/chalkboard
- Markers/chalk
- Multimedia projector and screen
- Desktop or laptop computer
- Appropriate personal protective equipment
- Copies of the latest edition of the National Electrical Code®
- Samples of RMC, IMC, and EMT conduit
- One piece of EMT per trainee
- PVC pieces
- PVC fittings
- PVC cement
- MSDSs for PVC cement and solvent
- Cutting oil
- Shop towels
- Tape measure
- Hickey with instruction manual
- Hand bender with instruction manual
- Calculator
- Hacksaw and blades
- File
- Miter box
- Pocket knife
- Torpedo level or square
- Pipe vise
- Pipe cutter
- Reamer
- Conduit dies and die heads
- Hand-operated threader
- Thread gauge
- Portable power drive (optional)
- Sandbox or drip pan
- Module Examinations*
- Performance Profile Sheets*

*Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires the trainee to use hand tools and solvents. Brief all trainees on shop safety procedures and point out fire extinguishers, first-aid stations, and other emergency equipment. Review hand tool safety and chemical 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 7½ hours are suggested to cover Hand Bending of Conduit. 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>
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<tbody>
<tr>
<td><strong>Session I. Introduction; Cutting, Reaming, and Threading Conduit</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Cutting Conduit</td>
<td></td>
</tr>
<tr>
<td>C. Reaming Conduit</td>
<td></td>
</tr>
<tr>
<td>D. Threading Conduit</td>
<td></td>
</tr>
<tr>
<td>E. Laboratory</td>
<td>Have trainees practice cutting and reaming EMT conduit. This laboratory corresponds to Performance Task 2.</td>
</tr>
<tr>
<td>F. Cutting and Joining PVC Conduit</td>
<td></td>
</tr>
<tr>
<td>G. Laboratory</td>
<td>Have trainees practice cutting and joining PVC conduit. This laboratory corresponds to Performance Task 3.</td>
</tr>
<tr>
<td><strong>Session II. Hand Bending Equipment, Part One</strong></td>
<td></td>
</tr>
<tr>
<td>A. Geometry Required to Make a Bend</td>
<td></td>
</tr>
<tr>
<td>B. Making a 90-Degree Bend</td>
<td></td>
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<tr>
<td>C. Back-to-Back 90-Degree Bends</td>
<td></td>
</tr>
<tr>
<td>D. Offsets</td>
<td></td>
</tr>
<tr>
<td>E. Laboratory</td>
<td>Have trainees practice using a hand bender, hacksaw, and reaming tool to make an offset, a 90-degree stub-up, and a back-to-back bend. This laboratory corresponds to Performance Task 1.</td>
</tr>
</tbody>
</table>
Session III. Hand Bending Equipment, Part Two; Review and Testing

A. Saddle Bends and Four-Bend Saddles

B. Laboratory

Have trainees practice making saddle bends. This laboratory corresponds to Performance Task 1.

C. Module Review

D. Module Examination

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

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

E. Performance Testing

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

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

This module introduces trainees to the requirements of the National Electrical Code®.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Electronic Systems Technician Level One, Modules 33101-10 through 33106-10.

Objectives

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

1. Describe the layout of the NEC®.
2. Demonstrate how to navigate the NEC®.
3. Describe the purpose of the National Electrical Manufacturers Association, the NFPA, and Nationally Recognized Testing Laboratories.

Performance Tasks

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

Materials and Equipment List

Pencils and scratch paper
Whiteboard/chalkboard
Markers/chalk

Multimedia projector and screen
Desktop or laptop computer
Copy of the latest edition of the National Electrical Code®
Module Examination*

*Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.

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.

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 *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.

### Topic Planned Time

#### Session I. Introduction; Purpose, History, and Layout of the NEC®
- **A. Introduction**
- **B. Purpose and History of the NEC®**
- **C. The Layout of the NEC®**

#### Session II. Navigating the NEC®, Part One
- **A. NEC Chapter 1, General**
- **B. NEC Chapter 2, Wiring and Protection**
- **C. NEC Chapter 3, Wiring Methods and Materials**
- **D. NEC Chapter 4, Equipment for General Use**
- **E. NEC Chapter 5, Special Occupancies**
- **F. NEC Chapters 6, 7, and 8, Special Equipment, Special Conditions, and Communications Systems**
- **G. NEC® Articles Containing Low-Voltage and/or Power-Limited Circuit Applications**

#### Session III. Navigating the NEC®, Part Two; Other Organizations; Review and Testing
- **A. Examples of Navigating the NEC®**
- **B. Canadian Electrical Code, Part 1**
- **C. Other Organizations**
- **D. Module Review**
- **E. Module Examination**
  1. Trainees must score 70% or higher to receive recognition from NCCER.
  2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.
Module Overview

This module covers the characteristics, identification, and applications of various types of conductors and cables used in telecommunications and security systems. It also describes the tools, materials, and procedures for pulling cables through conduit and raceways.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Electronic Systems Technician Level One, Modules 33101-10 through 33107-10.

Objectives

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

1. Explain the relationship between wire gauge and the current-carrying characteristics of a conductor.
2. Identify the common types of low-voltage cable and state their uses and limitations.
3. Explain the marking systems and color codes used to identify low-voltage cables.
4. Describe the equipment and techniques used for pulling cable in residential and commercial applications.
5. Explain the NEC® cable classifications and installation requirements for communication and fire alarm circuits.
6. Explain the premises and outside plant wiring requirements for telephone and data cabling.
7. Describe the effects of electromagnetic interference and the methods used to control it.
8. Use a wire gauge to select a specific wire size.
9. Identify cables by their markings.
10. Perform a cable pull using a fish tape or blower/vacuum unit.

Performance Tasks

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

1. Use a wire gauge to select a specific wire size.
2. Identify cables by their markings.
3. Perform a cable pull using a fish tape or blower/vacuum unit.

Materials and Equipment List

- Pencils and scratch paper
- Whiteboard/chalkboard
- Markers/chalk
- Multimedia projector and screen
- Desktop or laptop computer
- Appropriate personal protective equipment
- Copy of the latest version of the National Electrical Code®
- Samples of various types of wire and insulation
- Calculator
- Two-way radios or telephones
- Gloves
- Eye protection
- Fish tape
- Fish poles
- Power fishing system
- Basket grip
- Pull lines
- Cable caddy
- Wire lubricant
- Extension cords with GFCI protection
- Short ropes for temporary tie-offs
- Swivels
- Reel anchor
- Reel jacks
- Reel brakes
- Cable cutters
- 50' measuring tape
- Bullwheels
- Conduit swabs and brushes
- Mandrel
- Pistons
- Pulleys
Telescoping pole with hook
Power drills
Spade bits, bore bits, and flex bits
Stud locators
Video scanners
Wiring and pipe locators
Plaster cutters (power or hand)
Samples of the following:
  • Various conductors
  • Multi-mode and single-mode optical fiber cables
  • Cables with NEC® classification markings

• UTP, UTC, STP, STP-A, and ScTP communications cables and patch cords
• Coaxial cable (RG-59, RG-6, RG-11, RG-8, and RG-58)
Various sizes of cable on reels or in boxes, pay-out packs, or reels-in-a-box
Typical residential building plans showing cable pathways and head end equipment
Typical residential conduit, supports, and outlets
Module Examinations*
Performance Profile Sheets*

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.

*Available on the IRC (Instructor Resource Center) at www.NCERCInstructorIRC.com using the access code supplied with the Annotated Instructor’s Guide.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires the trainees to use power tools for cutting, drilling, and pulling cable. Brief trainees on shop safety procedures and point out fire extinguishers, first-aid stations, and other emergency equipment. Review basic electrical safety and power tool safety. Emphasize the use of personal protective equipment. This module may require that the trainees visit job sites. Ensure that trainees are briefed on job-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 20 hours are suggested to cover Low-Voltage Cabling. 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>
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<tbody>
<tr>
<td><strong>Session I. Introduction; Conductors and Insulation</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Conductor Wire Size</td>
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<tr>
<td>C. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees practice using a wire gauge to select the correct gauge of wire.</td>
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<tr>
<td>This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>D. Conductor Material</td>
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<tr>
<td>E. Insulation</td>
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</tbody>
</table>
Session II. Low-Voltage and Optical Fiber Cables

A. NEC® Classifications and Ratings
B. PLTC, Fire Alarm, and Class 2/3 Cable
C. Communication Cable
D. Optical Fiber Cable
E. Laboratory
   Have trainees practice identifying cable and interpreting cable markings. This laboratory corresponds to Performance Task 2.

Sessions III–VI. Commercial Low-Voltage Cable Installation

A. Pulling Equipment
B. Safety
C. Planning the Installation
D. Setting Up for Cable Pulling
E. Using Cable Pulling Equipment
F. Vertical and Horizontal Pulls
G. Laboratory
   Have trainees practice performing a cable pull using a fish tape or a blower/vacuum unit. This laboratory corresponds to Performance Task 3.

Sessions VII. Residential Low-Voltage Cable Installation

A. Residential Installation
B. Interior Low-Voltage Cabling Installation Requirements
C. Telephone Systems

Session VIII. EMI; Review and Testing

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