

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	Time sheets
Pencils and scratch paper	Job sheets
Whiteboard/chalkboard	Floor plans
EST 1 PowerPoint® Presentation Slides (ISBN 978-0-13-213792-8)	Cable stripping and termination tools:
Multimedia projector and screen	Coaxial cable crimp tool and replacement die
Desktop or laptop computer	Coaxial cable stripper
Appropriate personal protective equipment	Bix tool blade
Copies of the latest edition of the <i>National Electrical Code</i> ®	Punch-down tool
Examples of building codes and cabling standards	Coax compression tool
Copies of licensing examination test questions (if applicable in your state)	Soldering iron
A sample company policy or standard	Wire stripper/crimper
Copies of the following types of documents:	Examples of test instruments:
Contracts	Multimeter
Work statements	Telephone test set
Bills of material	LAN cable tester
As-built diagrams	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.

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

TIA/EIA Telecommunications Building Wiring Standards. Englewood, CO: Global Engineering.

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.

Topic	Planned Time
Session I. Introduction; Elements of Professionalism; Review and Testing	
A. Introduction	_____
B. Certification and Licensing	_____
C. Your Responsibilities as an Employee	_____
D. Industry Standards and Building Codes	_____
1. <i>National Electrical Code®</i>	_____
2. National Fire Protection Association	_____
3. National Building Codes	_____
4. Other Standards	_____
E. Documentation and Paperwork	_____
F. Laboratory	_____
Trainees practice filling out a time sheet and a job sheet. This laboratory corresponds to Performance Task 1.	
G. Your Training Program	_____
H. Tools of the Trade	_____
I. Module Review	_____
J. 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.	_____
K. 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 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	Engineered wood products
Whiteboard/chalkboard	Concrete blocks
Markers/chalk	Building brick
EST 1 PowerPoint® Presentation Slides (ISBN 978-0-13-213792-8)	Components of a wood framing system or an illustration of a framing system
Multimedia projector and screen	Operator's manuals for selected power tools
Desktop or laptop computer	Power screwdriver
Appropriate personal protective equipment	Drill
Rulers or measuring tape	Selection of drill bits and hole saws
Samples of typical construction materials:	Jig saw and blades
Dimension lumber	Reciprocating saw and blades
Plywood and building boards	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.

Topic	Planned Time
Session I. Introduction and Building Materials	
A. Introduction	_____
B. Building Materials	_____
1. Gypsum Board	_____
2. Masonry Materials	_____
Session II. Wood Frame Construction	
A. Sills	_____
B. Floor Construction	_____
C. Wall Construction	_____
D. Ceiling Construction	_____
E. Roof Construction	_____
F. Plank-and-Beam Framing	_____
G. Wall Framing in Masonry	_____
H. Walls Separating Occupancies	_____

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

Pencils and scratch paper	Operator's manuals for selected power tools
Whiteboard/chalkboard	Torque wrench
Markers/chalk	Drill
EST 1 PowerPoint® Presentation Slides (ISBN 978-0-13-213792-8)	Rotary hammer
Multimedia projector and screen	Selection of concrete drill bits
Desktop or laptop computer	Selection of concrete fasteners
Appropriate personal protective equipment	Selection of screws, nuts, and washers
Samples of the following construction materials:	Module Examinations*
Metal studs	Performance Profile Sheets*
Mechanical firestop devices	
Firestopping materials	

*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.

Basic Construction Materials, 6th Edition. 2002. Theodore W. Marotta. Upper Saddle River, NJ: Prentice Hall.

Principles and Practices of Light Construction, 6th Edition. 2004. Ronald C. Smith, Ted L. Honkala, and Malcolm W. Sharp. Upper Saddle River, NJ: Prentice Hall.

Principles and Practices of Commercial Construction, 7th Edition. 2004. Cameron K. Andres and Ronald C. Smith. Upper Saddle River, NJ: Prentice Hall.

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.

Topic	Planned Time
Session I. Introduction; Building Materials	
A. Introduction	_____
B. Building Materials	_____
1. Concrete	_____
2. Metal	_____
Session II. Commercial Construction Methods; Fire-Rated and Sound-Rated Walls	
A. Commercial Construction Methods	_____
1. Floors	_____
2. Exterior Walls	_____
3. Interior Walls and Partitions	_____
4. Roof Structure	_____
5. Ceilings	_____
B. Fire-Rated and Sound-Rated Walls	_____
1. Fire-Rated Construction	_____
2. Sound-Isolation Construction	_____
Session III. Fasteners and Anchors; Special Tools	
A. Fasteners and Anchors	_____
1. Threaded Fasteners	_____
2. Bolts and Screws	_____
3. Nuts and Washers	_____
4. Installing Fasteners	_____
5. Eye Bolts	_____

- 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	An assortment of conduit couplings and connectors
Whiteboard/chalkboard	Type C, Type L, Type T, and Type X conduit bodies
Markers/chalk	Threaded waterproof hub
EST 1 PowerPoint [®] Presentation Slides (ISBN 978-0-13-213792-8)	Insulating bushings
Multimedia projector and screen	Offset nipples
Desktop or laptop computer	Metal boxes
Appropriate personal protective equipment	PVC box
Copies of the latest edition of the <i>National Electrical Code</i> [®]	Concrete outlet boxes and extension rings
Sections of various types of conduit:	Bushings and locknuts
ENT	Sealing fittings
Inner duct	Selection of low-voltage boxes, mud rings, and face plates
EMT	An assortment of straps and ties
RMC	Beam clamps
Plastic-coated RMC	J-hooks
Aluminum conduit	Bridle rings
IMC	D-rings and half D-rings
EB and DB PVC	Mushroom posts
LFNC	Standoff support
Flexible metal conduit	

Wireway components:

- Connectors
- End plates
- Closing plates
- Tee fittings
- Crosses
- Elbows
- Nipples
- Slip fittings

Wireway hangers:

- Suspended
- Gusset

- Trapeze
- Center-hung support
- Selection of low-voltage boxes and mud rings
- Hand tools necessary for box installation
- Mounted drywall, cut-in boxes, and inner ducts for Performance Task 1
- Cable support hardware for Performance Task 2
- Copy of *ANSI/TIA/EIA-569*
- 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 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.

Information Transport Systems Installation Methods Manual (ITSIMM), 5th Edition. Tampa, FL: BICSI.
National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

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 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 *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.

Topic	Planned Time
Session I. Introduction; Raceways; Conduit	
A. Introduction	_____
B. Raceways	_____
C. Conduit	_____
1. Conduit as a Ground Path	_____
2. Electrical Nonmetallic Tubing	_____
3. Inner Duct	_____
4. Electrical Metallic Tubing	_____
5. Rigid Metal Conduit	_____
6. Plastic-Coated RMC	_____
7. Aluminum Conduit	_____
8. Black Enamel Steel Conduit	_____
9. Intermediate Metal Conduit	_____
10. Nonmetallic Conduit	_____
11. Flexible Metal Conduit	_____

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 (ISBN 978-0-13-213792-8)	Ice water
Multimedia projector and screen	Hot tap water
Desktop or laptop computer	Module Examinations*
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.

Fundamentals of Mechanical and Electrical Mathematics, 1996. Upper Saddle River, NJ: Prentice Hall.

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.

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

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	Hickey with instruction manual
Whiteboard/chalkboard	Hand bender with instruction manual
Markers/chalk	Calculator
EST 1 PowerPoint® Presentation Slides (ISBN 978-0-13-213792-8)	Hacksaw and blades
Multimedia projector and screen	File
Desktop or laptop computer	Miter box
Appropriate personal protective equipment	Pocket knife
Copies of the latest edition of the <i>National Electrical Code</i> ®	Torpedo level or square
Samples of RMC, IMC, and EMT conduit	Pipe vise
One piece of EMT per trainee	Pipe cutter
PVC pieces	Reamer
PVC fittings	Conduit dies and die heads
PVC cement	Hand-operated threader
MSDSs for PVC cement and solvent	Thread gauge
Cutting oil	Portable power drive (optional)
Shop towels	Sandbox or drip pan
Tape measure	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.

Benfield Conduit Bending Manual, 2nd Edition. Overland Park, KS: EC&M Books.

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

Tom Henry's Conduit Bending Package (includes video, book, and bending chart). Winter Park, FL: Code Electrical Classes, Inc.

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.

Topic	Planned Time
Session I. Introduction; Cutting, Reaming, and Threading Conduit	
A. Introduction	_____
B. Cutting Conduit	_____
C. Reaming Conduit	_____
D. Threading Conduit	_____
E. Laboratory	_____
Have trainees practice cutting and reaming EMT conduit. This laboratory corresponds to Performance Task 2.	
F. Cutting and Joining PVC Conduit	_____
G. Laboratory	_____
Have trainees practice cutting and joining PVC conduit. This laboratory corresponds to Performance Task 3.	
Session II. Hand Bending Equipment, Part One	
A. Geometry Required to Make a Bend	_____
B. Making a 90-Degree Bend	_____
C. Back-to-Back 90-Degree Bends	_____
D. Offsets	_____
E. Laboratory	_____
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.	

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

EST 1 PowerPoint® Presentation Slides
(ISBN 978-0-13-213792-8)

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.

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

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 *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. <i>NEC Chapter 1, General</i>	_____
B. <i>NEC Chapter 2, Wiring and Protection</i>	_____
C. <i>NEC Chapter 3, Wiring Methods and Materials</i>	_____
D. <i>NEC Chapter 4, Equipment for General Use</i>	_____
E. <i>NEC Chapter 5, Special Occupancies</i>	_____
F. <i>NEC Chapters 6, 7, and 8, Special Equipment, Special Conditions, and Communications Systems</i>	_____
G. <i>NEC</i> ® 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. <i>Canadian Electrical Code, Part 1</i>	_____
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	Power fishing system
Whiteboard/chalkboard	Basket grip
Markers/chalk	Pull lines
EST 1 PowerPoint [®] Presentation Slides (ISBN 978-0-13-213792-8)	Cable caddy
Multimedia projector and screen	Wire lubricant
Desktop or laptop computer	Extension cords with GFCI protection
Appropriate personal protective equipment	Short ropes for temporary tie-offs
Copy of the latest version of the <i>National Electrical Code</i> [®]	Swivels
Samples of various types of wire and insulation	Reel anchor
Calculator	Reel jacks
Standard wire gauge	Reel brakes
Two-way radios or telephones	Cable cutters
Gloves	50' measuring tape
Eye protection	Bullwheels
Fish tape	Conduit swabs and brushes
Fish poles	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*

*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, 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.

Information Transport Systems Installation Methods Manual (ITSIMM), Latest Edition. Tampa, FL: BICSI.

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

Telecommunications Distribution Methods Manual, Latest Edition. Tampa, FL: BICSI.

TIA/EIA Building Telecommunications Wiring Standards, Latest Edition. Englewood, CO: Global Engineering Documents.

The Cabling Handbook, Latest Edition. Upper Saddle River, NJ: Prentice Hall.

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.

Topic	Planned Time
Session I. Introduction; Conductors and Insulation	
A. Introduction	_____
B. Conductor Wire Size	_____
C. Laboratory	_____
Have trainees practice using a wire gauge to select the correct gauge of wire. This laboratory corresponds to Performance Task 1.	
D. Conductor Material	_____
E. Insulation	_____

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.
