

Module Overview

This module introduces the trainee to DC electrical circuits. It offers a general introduction to electrical concepts used in Ohm's law. It includes atomic theory, electromagnetic force, resistance, and electric power equations, and describes series, parallel, and series-parallel circuits.

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*.

Objectives

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

1. Define voltage and identify the ways in which it can be produced.
2. Explain the difference between conductors and insulators.
3. Define the units of measurement for the properties of electricity.
4. Explain the basic characteristics of series, parallel, and series-parallel circuits.
5. Using Kirchhoff's voltage law, calculate the voltage drop in series, parallel, and series-parallel circuits.
6. Using Kirchhoff's current law, calculate the total current in series, parallel, and series-parallel circuits.
7. Using Ohm's law, find the unknown parameters in series, parallel, and series-parallel circuits.

Performance Tasks

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

Materials and Equipment

Markers/chalk	Examples of conductors, insulators, and semiconductors
Pencils and scratch paper	Magnets
Whiteboard/chalkboard	Simple electromagnet
<i>Electronic Systems Technician Level Two</i> PowerPoint® Presentation Slides (ISBN 978-0-13-257332-0)	Metal sheet
Multimedia projector and screen	Iron filings
Computer	Battery
Basic electrical circuit, including:	Sample schematics
Battery/power source	Color-coded resistors
Wiring	Multimeter
Loads	Copies of the Quick Quiz*
Switches	Module Examinations**

*Located at the back of this module

**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review basic electrical safety. 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 presents thorough resources for task training. The following resource material is suggested for further study.

Electronics Fundamentals: Circuits, Devices, and Applications, Thomas L. Floyd. New York: Prentice Hall.

Principles of Electric Circuits, Thomas L. Floyd. New York: 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 15 hours are suggested to cover *DC Circuits*. 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; Atomic Theory; Electrical Power Generation	
A. Introduction	_____
B. Atomic Theory	_____
1. The Atom	_____
2. Conductors and Insulators	_____
3. Magnetism	_____
C. Electrical Power Generation and Distribution	_____
Session II. Electric Charge and Current; Ohm's Law	
A. Electric Charge and Current	_____
1. Current Flow	_____
2. Voltage	_____
3. Resistance	_____
B. Ohm's Law	_____
Session III. Schematic Representation; Resistors; Electrical Power	
A. Schematic Representation of Circuit Elements	_____
B. Resistors	_____
1. Resistor Color Codes	_____
C. Electrical Power	_____
1. Power Equation	_____
2. Power Rating of Resistors	_____
Session IV. DC Circuits; Solving Resistance Problems	
A. DC Circuits	_____
1. Series Circuits	_____
2. Parallel Circuits	_____
3. Series-Parallel Circuits	_____
B. Solving Resistance Problems	_____
1. Resistances in Series	_____
2. Resistances in Parallel	_____
3. Series-Parallel Circuits	_____

Module Overview

This module provides an introduction to AC theory, circuits, and components including inductors, capacitors, and transformers. It covers the calculation of reactance and impedance in RL, RC, LC, and RLC circuits using math and vector analysis.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Electronic Systems Technician Level One*; and *Electronic Systems Technician Level Two*, Module 33201-10.

Objectives

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

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

Performance Tasks

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

Materials and Equipment

Markers/chalk	Calculator
Pencils and scratch paper	Common capacitors
Whiteboard/chalkboard	Inductors, resistors, capacitors, power sources, and wiring to build RL, RC, RLC, and LC circuits
<i>Electronic Systems Technician Level Two</i> PowerPoint® Presentation Slides (ISBN 978-0-13-257332-0)	Voltmeter
Multimedia projector and screen	Transformers
Computer	Copies of the Quick Quiz*
Appropriate personal protective equipment	Module Examinations**

*Located at the back of this module

*Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Ensure that trainees are briefed on basic electrical safety and shop safety policies.

Additional Resources

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

Principles of Electric Circuits: Conventional Current Version, 2002. Thomas L. Floyd. New York, NY: 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 *AC Circuits*. 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; Sine Wave Generation and Terminology	
A. Introduction	_____
B. Sine Wave Generation	_____
C. Sine Wave Terminology	_____
Session II. AC Phase Relationships; Nonsinusoidal Waveforms; Resistance	
A. AC Phase Relationships	_____
B. Nonsinusoidal Waveforms	_____
C. Resistance in AC Circuits	_____
Session III. Inductance and Capacitance	
A. Inductance in AC Circuits	_____
B. Capacitance	_____
Session IV. Types of AC Circuits	
A. Types of AC Circuits	_____
1. RL Circuits	_____
2. RC Circuits	_____
3. LC Circuits	_____
4. RLC Circuits	_____
Session V. Power in AC Circuits	
A. Power in AC Circuits	_____
B. True Power	_____
C. Apparent Power	_____
D. Reactive Power	_____
E. Power Factor	_____
F. Power Triangle	_____
Sessions VI and VII. Transformers	
A. Transformers	_____
B. Transformer Construction	_____
C. Operating Characteristics	_____
D. Turns and Voltage Ratios	_____
E. Types of Transformers	_____
F. Transformer Selection	_____

Session VIII. Review and Testing

A. Module Review

B. 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 describes different types and configurations of switches, relays, timers, and photoelectric devices and explains their operating principles. Guidelines are presented for using specification sheets to select an appropriate device for a specific application.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Electronic Systems Technician Level One*; and *Electronic Systems Technician Level Two*, Modules 33201-10 and 33202-10.

Objectives

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

1. Identify and describe the operation of commonly used types of switches.
2. Classify switches based on schematic diagram symbols, according to the number of poles and throws.
3. Identify photoelectric devices and describe how they operate.
4. Describe the applications and operation of relays.
5. Explain the differences between electromechanical and solid-state relays.
6. Identify different types of timing devices and describe how they operate.
7. Select, install, and test a relay for a stated application.

Performance Tasks

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

1. Identify and select various types of switches for the specific application.
2. Select, install, and test a relay for a stated application.

Materials and Equipment

Pencils and scratch paper	Machine control relay
Whiteboard/chalkboard	Solid-state relay
Markers/chalk	Dashpot timer relay
<i>Electronic Systems Technician Level Two</i>	Pneumatic timer
PowerPoint® Presentation Slides (ISBN 978-0-13-257332-0)	Time clock or timer relay
Multimedia projector and screen	Solid-state timer
Computer	Photocell switcher
Appropriate personal protective equipment	Solar cells
Samples or pictures of the following devices:	Motion detectors
Single-pole switch	Proximity switch
Three-way switch	Specification sheets and/or manufacturer's product catalogs/data sheets for various switches, relays, timers, time clocks, and photoelectric devices
Double-pole switch	Test light
Float switch	Ohmmeter
Pneumatic switch	Wiring, relays, photocells, motion detectors, loads, and switches to build simple circuits
Limit switch	Module Examinations*
SCR	Performance Profile Sheets*
Reed relay	
General-purpose relay with plug-in base	

*Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires that the trainees build circuits and operate various electrical meters. Ensure that trainees are briefed on basic electrical safety and shop safety policies.

Additional Resources

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

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 15 hours are suggested to cover *Switching Devices and Timers*. 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; Switches	
A. Introduction	_____
B. Switches	_____
1. Switch Classifications	_____
2. Switch Descriptions	_____
C. Laboratory	_____
Have trainees identify and select various types of switches for specific applications. This laboratory corresponds to Performance Task 1.	
Sessions II. and III. Photoelectric Devices; Proximity Sensors	
A. Photoelectric Devices	_____
1. Photocell Switches	_____
2. Solar Cells	_____
3. Infrared Devices	_____
4. Fiber-Optic Switching Devices	_____
5. Magnetic Switches	_____
B. Proximity Sensors	_____
Sessions IV. and V. Electrical Relays and Timers	
A. Electrical Relays	_____
1. Electromechanical Relays	_____
2. Solid-State Relays	_____
3. Relay Selection	_____
B. Laboratory	_____
Have trainees select, install, and test relays for specific applications. This laboratory corresponds with Performance Task 2.	
C. Timers	_____
1. Solid-State Timers	_____
2. Programmable Electronic Time Switches	_____

Session VI. Review and Testing

A. Module Review

B. 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.

C. Performance Testing

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

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

Module Overview

This module provides an introduction to the principles of electronics and semiconductor theory, components, and applications.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Electronic Systems Technician Level One*; and *Electronic Systems Technician Level Two*, Modules 33201-10 through 33203-10.

Objectives

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

1. Identify electronic system components.
2. Describe the materials and electrical characteristics of solid-state devices.
3. Identify the various types of transistors and explain how they operate.
4. Describe and connect diodes including:
 - Rectifiers
 - Light-emitting diodes (LEDs)
 - Silicon-controlled rectifiers (SCRs)
5. Identify the leads of various solid-state devices.
6. Describe integrated circuits.
7. Identify a microprocessor and applicable pin numbers.
8. Explain the purpose of logic gates.
9. Build a simple circuit that includes a solid-state device.

Performance Tasks

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

1. Identify the leads of various solid-state devices.
2. Identify a microprocessor and applicable pin numbers.
3. Build a simple circuit that includes a solid-state device.

Materials and Equipment

Markers/chalk	Selection of diodes, LEDs, transistors, and SCRs
Pencils and scratch paper	Multimeter
Whiteboard/chalkboard	Grounding strap
<i>Electronic Systems Technician Level Two</i>	ESD protection products
PowerPoint® Presentation Slides	Selection of schematic and logic diagrams
(ISBN 978-0-13-257332-0)	Selection of printed circuit boards, sealed
Multimedia projector and screen	components, integrated circuits, and
Computer	microprocessors
Appropriate personal protective equipment	Pushbutton
24V transformer with a plug and power cord	Components and wire to connect basic test circuits
Filter capacitor	Module Examinations*
Oscilloscope	Performance Profile Sheets*

*Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires that the trainees build circuits and operate various electrical meters. Ensure that trainees are briefed on basic electrical safety and shop safety policies.

Additional Resources

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

National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.
Solid State Fundamentals for Electricians, 2001. Gary Rockis. Homewood, IL: American Technical Publishers.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Semiconductors and Integrated Circuits*. 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; Semiconductor Fundamentals; Diodes	
A. Introduction	_____
B. Semiconductor Fundamentals	_____
C. Diodes	_____
D. Laboratory	_____
Have trainees practice building a simple circuit that includes a solid-state device. This laboratory corresponds to Performance Task 3.	
Session II. LEDs; Photo and Zener Diodes; Transistors and Rectifiers	
A. Light-Emitting Diodes	_____
B. Laboratory	_____
Have trainees practice identifying the leads of various solid-state devices. This laboratory corresponds to Performance Task 1.	
C. Photo Diodes	_____
D. Zener Diodes	_____
E. Transistors	_____
F. Rectifiers	_____
G. Silicon-Controlled Rectifiers	_____
Session III. Diacs; Triacs; Printed Circuit Boards	
A. Diacs	_____
B. Triacs	_____
C. Printed Circuit Boards	_____
D. Laboratory	_____
Have trainees identify a microprocessor and applicable pin numbers. This laboratory corresponds with Performance Task 2.	

Session IV. Operational Amplifiers and Digital Gates; Review and Testing

A. Operational Amplifiers

B. Basic Digital Gates

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.

Test Equipment Annotated Instructor's Guide

Module 33205-10

Module Overview

This module describes the selection, inspection, use, and maintenance of the analog and digital meters used in the installation and checkout of electronic systems.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Electronic Systems Technician Level One*; and *Electronic Systems Technician Level Two*, Modules 33201-10 through 33204-10.

Objectives

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

1. Describe and explain the operation of the following pieces of test equipment:
 - Ammeter
 - Voltmeter
 - Ohmmeter
 - Multimeter
 - Continuity tester
 - Voltage tester
 - Electrical outlet tester
2. Explain the operation and use of specialized test equipment used in the checkout and troubleshooting of electronic equipment, cables, and cabling systems.
3. Select the correct item of test equipment to be used in specific situations.
4. Describe how to measure and generate various waveforms.
5. Set up and use selected cable testers to check out cables and evaluate the performance of copper and optical fiber cable.

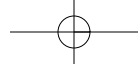
Performance Tasks

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

1. Measure AC/DC voltage, current, and resistance using a multimeter.
2. Set up and use selected cable testers to check out cables and evaluate the performance of copper and optical fiber cable.

Materials and Equipment

Markers/chalk	Assortment of cables for test purposes
Whiteboard/chalkboard	Various test instruments and their operation manuals, including:
Pencils and scratch paper	• Ammeter
<i>Electronic Systems Technician Level Two</i> PowerPoint®	• Voltmeter
Presentation Slides (ISBN 978-0-13-257332-0)	• Ohmmeter
Multimedia projector and screen	• Multimeter (analog and digital)
Computer	• Continuity tester
Appropriate personal protective equipment	• Voltage tester
Grounding strap	• Oscilloscope
Power supplies, circuit boards, or equipment used as a source of test voltages and currents	• Wattmeter
Signal or function generator, or other source of test waveforms	• Megohmmeter
Batteries	• Line frequency meter
Resistors	• Frequency counter
Components and wire to connect basic test circuits	• Power factor meter
	• Recording instruments



Lineman's test set
 Cable toner
 Cable certification tester
 Sound pressure level meter
 Time domain reflectometer
 RF power meter

Signal level meter
 TDR/OTDR
 Spectrum analyzer
 Signal generator
 Module Examinations*
 Performance Profile Sheets*

*Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

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 test electronic circuits with various electrical instruments. Ensure that trainees are briefed on basic electrical safety and shop safety policies. Review safety guidelines for all test instruments used, especially the megohmmeter.

Additional Resources

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

Electronics Fundamentals: Circuits, Devices, and Applications, 2004. Thomas L. Floyd. New York: Prentice Hall.

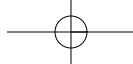
Principles of Electric Circuits: Conventional Current Version, 2003. Thomas L. Floyd. New York: Prentice Hall.

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 10 hours are suggested to cover *Test Equipment*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Types of Meters	
A. Introduction	_____
B. Meters	_____
C. Ammeter	_____
D. Voltmeter	_____
E. Ohmmeter	_____
F. Multimeters	_____
G. Digital Meters	_____
H. Laboratory	_____
Have trainees measure AC/DC voltage, current, and resistance using a multimeter. This laboratory corresponds with Performance Task 1.	
Session II. Continuity and Voltage Testers; Oscilloscopes	
A. Continuity Tester	_____
B. Voltage Tester	_____
C. Oscilloscopes	_____





Session III. Wattmeters; Meggers; Line, Cable, and Signal Meters

- A. Wattmeter
- B. Megohmmeter (Megger)
- C. Line Frequency Meter
- D. Power Factor Meter
- E. Recording Instruments
- F. Lineman's Test Set
- G. Cable Toner
- H. Cable Certification Testers
- I. Sound Pressure Level Meters
- J. RF Power Meter
- K. Signal Level Meter
- L. Time-Domain Reflectometer
- M. Spectrum Analyzer
- N. Signal Generators
- O. Category Ratings
- P. Testing and Troubleshooting
- Q. Safety
- R. Laboratory

Have trainees set up and use selected cable testing equipment to check out cables and evaluate the performance of copper and optical fiber links. This laboratory corresponds with Performance Task 2.

Session IV. Review and Testing

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

Module Overview

This module provides trainees with an introduction to electrical prints, drawings, and symbols. Trainees learn the types of information they can find on schematics, one-line drawings, and wiring diagrams.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Electronic Systems Technician Level One*; and *Electronic Systems Technician Level Two*, Modules 33201-10 through 33205-10.

Objectives

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

1. Identify the elements of a drawing set.
2. Identify and describe the types of drawings commonly used in low-voltage work.
3. Identify the types of lines and symbols used on electrical drawings.
4. Describe and demonstrate the use of an architect's and engineer's scales.
5. Interpret drawings, including site plans, floor plans, detail drawings, and wiring diagrams.
6. Describe the type of information included in electrical specifications.
7. Look up devices on drawings and perform a takeoff.

Performance Tasks

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

1. Demonstrate the use of an architect's and engineer's scale.
2. Interpret electrical drawings, including site plans, floor plans, detail drawings, and schedules.
3. Perform a takeoff of low-voltage cabling and material using drawings provided by the instructor.

Materials and Equipment

Markers/chalk	Engineer's scale
Pencils and scratch paper	Standard 12-inch ruler
Whiteboard/chalkboard	Metric ruler
<i>Electronic Systems Technician Level Two</i>	Electronic wheel scaler
PowerPoint® Presentation Slides (ISBN 978-0-13-257332-0)	Scientific calculator
Multimedia projector and screen	Appropriate personal protective equipment
Computer	Golf ball
Various electrical drawings, schedules, site plans, floor plans, etc.	Vise
Architect's scale	Hacksaw
	Module Examinations*
	Performance Profile Sheets*

*Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Additional Resources

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

National Electrical Code®, 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 10 hours are suggested to cover *Introduction to Electrical Drawings*. 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 to Electrical Drawings	
A. Introduction	_____
B. Drawing Layout	_____
C. Drafting Lines	_____
D. Electrical Symbols	_____
Session II. Scale Drawings; Types of Electrical Drawings	
A. Scale Drawings	_____
B. Analyzing Electrical Drawings	_____
C. Typical Site Electrical Plan	_____
D. Power Plans	_____
E. Special Electrical System Plans	_____
F. Laboratory	_____
Have trainees demonstrate the proper use of architect's and engineer's scales. This laboratory corresponds with Performance Task 1.	
Session III. Electrical Details and Diagrams; Written Specifications; Quantity Takeoffs; As-Built Drawings	
A. Electrical Details and Diagrams	_____
B. Written Specifications	_____
C. Laboratory	_____
Have trainees interpret various types of electrical drawings, site plans, floor plans, detail drawings, and schedules. This laboratory corresponds with Performance Task 2.	
D. Quantity Takeoffs	_____
E. As-Built Drawings	_____
F. Laboratory	_____
Using drawings provided by the instructor, have trainees perform a takeoff of low-voltage cabling and material. This laboratory corresponds with Performance Task 3.	
Session IV. Review and Testing	
A. Module Review	_____
B. 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.	
C. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.	

Introduction to Codes and Standards Annotated Instructor's Guide

Module 33207-10

Module Overview

This module describes the scope and content of the major codes and standards that apply to telecommunications, life safety, security, and other low-voltage systems. Emphasis is placed on familiarization with and use of the National Electrical Code® (NEC®).

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Electronic Systems Technician Level One; and Electronic Systems Technician Level Two*, Modules 33201-10 through 33206-10.

Objectives

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

1. Identify trade-relevant codes and standards, and identify the differences between them.
2. Explain how to find and use information in the National Electrical Code® (NEC®).
3. Use a code or standard to determine the specific requirements for a given application.
4. Explain the role of testing laboratories.

Performance Tasks

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

1. Use a code or standard to determine the specific requirements for a given application.

Materials and Equipment

Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

Electronic Systems Technician Level Two

PowerPoint® Presentation Slides
(ISBN 978-0-13-257332-0)

Multimedia projector and screen

Computer

Copies of the latest ANSI/TIA/EIA standards:

ANSI/TIA/EIA-568, Commercial Building Telecommunications Cabling Standard Plus Addenda 1 through 3, and Telecommunications Systems Bulletins TSB-67, TSB-72, and TSB-75

ANSI/TIA/EIA-569-B, Commercial Building Standards for Telecommunications Pathways and Spaces

ANSI/TIA/EIA-570-B, Residential Telecommunications Cabling Standard

ANSI/TIA/EIA-606, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

ANSI/TIA/EIA-607, Commercial Building Grounding and Bonding Requirements for Telecommunications

Copies of the latest IEEE standards:

Standard 802.3, CSMA/CD Access Method

Standard 1394, Standard for a High-Performance Serial Bus

Copy of the latest edition of the *International Building Code®*

Copy of the latest edition of the *Uniform Building Code™*

Copy of the latest edition of the *Standard Building Code*

Examples of industry and company standards

Examples of manufacturer's instructions

Module examinations*

Performance Profile Sheets*

*Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

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

Additional Resources

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

ANSI/TIA/EIA Standards Latest Edition, available from Global Engineering Documents, Englewood, CO.
 ANSI/TIA/EIA-568, *Commercial Building Telecommunications Cabling Standard Plus Addenda 1 through 3, and Telecommunications Systems Bulletins TSB-67, TSB-72, and TSB-75*
 ANSI/TIA/EIA-569, *Commercial Building Standards for Telecommunications Pathways and Spaces*
 ANSI/TIA/EIA-570, *Residential Telecommunications Cabling Standard*
 ANSI/TIA/EIA-606, *Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*
 ANSI/TIA/EIA-607, *Commercial Building Grounding and Bonding Requirements for Telecommunications*

IEEE Standards, Latest Edition. Piscataway, NJ: Institute of Electrical and Electronic Engineers.
Standard 802.3, CSMA/CD Access Method
Standard 802.5, Token Ring Access Method
Standard 1394, Standard for a High Performance Serial Bus
 International Building Code, Falls Church, VA: International Code Council.

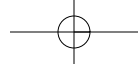
NFPA Codes, Latest Edition. Quincy, MA: National Fire Protection Association.
 NFPA 5000, *Building Construction and Safety Code*[®]
 NFPA 13, *Installation of Sprinkler Systems*
 NFPA 13D, *Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*
 NFPA 13R, *Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height*
 NFPA 70, *National Electrical Code*[®]
 NFPA 72, *National Fire Alarm and Signaling Code*[®]
 NFPA 75, *Protection of Information Technology Equipment*
 NFPA 77, *Recommended Practice on Static Electricity*
 NFPA 101, *Life Safety Code*[®]
 NFPA 780, *Standard for Installation of Lightning Protection Systems*

SCTE Standards, Latest Edition. Exton, PA: Society of Cable Telecommunications Engineers.
 ANSI/SCTE 74 2003 (formerly IPS SP 001), *Specification for Braided 75 Ohm Flexible RF Coaxial Drop Cable*

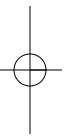
Websites:
www.bicsi.org
www.nfpa.org
www.tiaonline.org

Teaching Time for this Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Introduction to Codes and Standards*. 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; Overview of Codes and Standards	
A. Introduction	_____
B. The Purpose of Codes and Standards	_____
C. Determining Which Codes and Standards to Follow	_____
D. Words with Special Meanings	_____
E. Code Deviations and Conflicts	_____
Session II. The National Electrical Code®	
A. The National Electrical Code®	_____
B. Laboratory	_____
Have trainees practice using the National Electrical Code® to determine the specific requirements for a given telecommunications and/or life safety system application. This laboratory corresponds to Performance Task 1.	
Session III. NFPA; Building Codes; Telecommunication and Related Standards	
A. <i>National Fire Alarm and Signaling Code® (NFPA 72®)</i>	_____
B. <i>Life Safety Code® (NFPA 101®)</i>	_____
C. Other NFPA Codes	_____
D. Building Codes	_____
E. Telecommunication Standards	_____
F. Related Standards	_____
G. Laboratory	_____
Have trainees practice using applicable ANSI/TIA/EIA standards to determine the specific requirements for a given telecommunications and/or life safety system application. This laboratory corresponds to Performance Task 1.	
Session IV. Testing Laboratories; Review and Testing	
A. Testing Laboratories	_____
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.	



Module Overview

This module covers the properties of common types of low-voltage cable and fiber-optic cable used in signaling and communication systems. It describes the main cable types along with their physical and performance specifications. Guidelines for selecting and sizing the right cable for a given application are also presented.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Electronic Systems Technician Level One*; and *Electronic Systems Technician Level Two*, Modules 33201-10 through 33207-10.

Objectives

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

1. Select cables for specific applications.
2. Calculate the voltage drop for various applications.
3. Interpret and apply *NEC*[®] regulations governing conductors and cables.
4. Size cable conductors for a given load.
5. Understand and apply various formulas and charts for load calculations.

Performance Tasks

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

1. Select and size cable for specific applications.
2. Calculate the voltage drop for various applications.
3. Size cable conductors for a load using various load calculation charts.

Materials and Equipment

Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

Electronic Systems Technician Level Two

PowerPoint[®] Presentation Slides

(ISBN 978-0-13-257332-0)

Multimedia projector and screen

Appropriate personal protective equipment

Computer

Calculator

Samples of different types of coax and data cable

Copies of the Quick Quiz*

Module Examinations**

Performance Profile Sheets**

*Located at the back of this module

**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

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

Additional Resources

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

National Electrical Code Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.
Cabling: The Complete Guide to Network Wiring. San Francisco, CA: Sylvex.
A Practical Guide to Cable Selection. Santa Clara, CA: National Semiconductor Corporation.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Cable Selection*. 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; Cable Selection; Fire Alarm and Security Systems	
A. Introduction	_____
B. Common Factors in Cable Selection	_____
C. Fire Alarm and Security System Cabling	_____
Session II. Coaxial Cable Selection; Telecommunications and Data Cable; Optical Multi-Fiber Cable	
A. Coaxial Cable Selection	_____
B. Telecommunications and Data Cable	_____
C. Optical Multi-Fiber Cable	_____
D. Laboratory	_____
Have trainees select and size cable for specific applications. This laboratory corresponds to Performance Task 1.	
Session III. Voltage and Power Drop	
A. Conductor Voltage Drop	_____
B. Coaxial Cable Voltage Drop	_____
C. Speaker Cable Power Drop	_____
D. Laboratory	_____
Have trainees calculate the voltage drop for various applications. This laboratory corresponds to Performance Task 2.	
E. Laboratory	_____
Have trainees size cable conductors for a load using various load calculation charts. This laboratory corresponds to Performance Task 3.	
Session IV. Review and Testing	
A. Module Review	_____
B. 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.	
C. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.	

Module Overview

This module provides information and detailed instructions for selecting, installing, and testing connectors and other terminating devices on the various cables used in low-voltage work, including telecommunications, video and audio, and fiber optics.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Electronic Systems Technician Level One*; and *Electronic Systems Technician Level Two*, Modules 33201-10 through 33208-10.

Objectives

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

1. Describe the connectors, tools, and methods used to terminate telecommunications cable.
2. Describe the connectors, tools, and methods used to terminate coaxial cable.
3. Describe the connectors, tools, and methods that apply to solderless connectors.
4. Describe the soldering process.
5. Prepare and terminate UTP and coaxial cable.
6. Splice conductors using solderless connectors.

Performance Tasks

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

1. Properly prepare and terminate a cable or wire with various types of connectors.

Materials and Equipment

Markers/chalk	Time-domain reflectometer
Pencils and scratch paper	Wire cutters
Whiteboard/chalkboard	Stripping tools
<i>Electronic Systems Technician Level Two</i>	Coaxial cable stripper
PowerPoint® Presentation Slides (ISBN 978-0-13-257332-0)	Screwdriver
Multimedia projector and screen	Pliers
Computer	Diagonal cutting tool
Appropriate personal protective equipment	Category 1 and 2 telephone wiring jacks and connectors
Various types of coaxial cable	Category 3 and higher cable
Coaxial cable connectors, including:	Snap-in station outlet couplers
F-type connectors	Punchdown blocks
BNC connectors	Patch cord plugs
Literature and instructions from connector manufacturers	Pre-assembled patch cords
Manufacturer's literature on communications/data network equipment	Wire/cable management devices
Crimping and assembly tools, including:	Soldering iron
Punchdown tool	Solder
Plier-type crimping tool	Soldering flux
Leveraged crimping tool	Desoldering pump
Modular plug crimping tool	ANSI/TIA/EIA-586A-compliant data communications cables
Multimeter	Shielded twisted-pair cable
	Workstation coupler plugs and jacks

(continued)

Compact 5e modules
 Surface-mount box
 Modular plugs
 Type 66 and 110 blocks and block plugs
 IDC termination blocks
 Cable management hardware
 Crimp connectors for screw terminals

Splice-type crimp connectors
 Wire nuts
 Multipair punchdown/cutoff tools
 Fiber-optic connectors
 Module Examinations*
 Performance Profile Sheets*

*Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires that the trainees use various electrical hand tools and a soldering iron. Ensure that trainees are briefed on basic hand tool safety, electrical safety, and shop safety policies.

Additional Resources

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

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, 11th Edition. 2006. Tampa, FL: BICSI. www.bicsi.org.
TIA/EIA Building Telecommunications Wiring Standards, 9th Edition. Englewood, CO: Global Engineering Documents.
The Cabling Handbook, 2nd Edition. 2000. 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 25 hours are suggested to cover *Wire and Cable Terminations*. 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; Coaxial Cable Terminations	
A. Introduction	_____
B. Coaxial Cable Terminations	_____
Sessions II– III. Terminating UTP Cable	
A. Types of UTP Connectors	_____
B. UTP Cable Management	_____
C. Consolidation Point or Cross-Connect Block Terminations	_____
D. Type 110 Block Terminations	_____
E. Workstation Coupler or Modular Jack Terminations	_____
F. Surface-Mount Box Terminations	_____
G. Modular Plug/Cord Fabrication and Termination	_____
H. Patch Cord and 110 Block Plug Termination	_____
I. Testing Twisted-Pair Cable	_____

Sessions IV– VI. Solderless Connections

- A. Crimp Connectors for Screw Terminals _____
- B. Splice-Type Crimp Connections _____
- C. Wire Nuts _____
- D. Cable/Conductor Routing and Inspection _____
- E. Termination of Conductors/Cables to Solderless Connectors _____
- F. Terminating Typical Shielded Cable _____

Sessions VII and VIII. Solder-Type Connectors

- A. Solder _____
- B. Soldering Flux _____
- C. Soldering Irons _____
- D. The Soldering Process _____
- E. Soldering Safety _____
- F. Terminating an RCA Connector _____
- G. Terminating an XLR Connector _____

Session IX. Optical Fiber Cable Connectors; Legacy Connectors; Laboratory

- A. Optical Fiber Cable Connectors _____
- B. Legacy Communications Connectors and Terminations _____
- C. Laboratory _____

Have trainees properly prepare and terminate cables and wires with various types of connectors. This exercise corresponds with Performance Task 1.

Session X. Review and Testing

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

Module Overview

This module provides instruction on the fundamentals of power systems and their grounding schemes. It examines conditions that can cause poor power quality, as well as the equipment and devices that correct or protect against power quality degradation.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Electronic Systems Technician Level One*; and *Electronic Systems Technician Level Two*, Modules 33201-10 through 33209-10.

Objectives

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

1. Explain the purpose of grounding.
2. Determine the *National Electrical Code*[®] (*NEC*[®]) requirements for electrical system and telecommunications equipment grounding.
3. Recognize and describe the purpose of the components used for grounding and bonding a telecommunications system in a typical commercial multistory building.
4. Recognize and describe the purpose for using various AC power system protection and conditioning devices, including:
 - Isolation transformers
 - Surge protecting devices
 - Power line conditioners
 - Harmonic and noise suppression filters
 - Motor and engine-generator sets
 - Uninterruptible power supplies
5. Select and test DC power supplies used in electronic equipment.
6. Describe cable shielding and grounding techniques used to minimize EMI.

Performance Tasks

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

1. Select and test DC power supplies used in electronic equipment.

Materials and Equipment

Multimedia projector and screen
Electronic Systems Technician Level Two
PowerPoint[®] Presentation Slides
(ISBN 978-0-13-257332-0)
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Computer
Calculator
Copy of latest edition of the *National Electrical Code*[®] (*NEC*[®])

Copies of *NEC Article 250*
Selection of isolation transformers and surge protection devices
Manufacturer's data sheets/catalogs for system protection and conditioning devices
Metal oxide varistors
Voltage regulators
Examples of UPS systems
VOM/DMM
Oscilloscope
Battery charger system
Shielded cables

(continued)

Selection of DC power supplies and test equipment along with manufacturer's catalog/data sheets
 Copies of the Quick Quiz*

Module Examinations**
 Performance Profile Sheets**

*Located in the back of this module

**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires that the trainees work with electronic test circuits. Ensure that trainees are briefed on basic electrical safety and shop safety policies. Review safety guidelines for all test instruments used. This module requires that trainees visit job sites. Ensure that trainees are briefed on all site safety protocols.

Additional Resources

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

National Electrical Code® Handbook, Latest edition. Quincy, MA: National Fire Protection Association.
Information Transport Systems Manual, Latest edition. 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 20 hours are suggested to cover *Power Quality and Grounding*. 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; Overview of Electrical System Grounding	
A. Introduction	_____
B. Premises Wiring	_____
C. Overview of Premises Electrical System Grounding	_____
Session II. System and Equipment Grounding	
A. Basic Grounding System	_____
B. Grounding Electrode System/Electrode Conductor	_____
C. Equipment Grounding System	_____
D. Bonding and Grounding/Telecommunications Systems	_____
Session III. Causes of Poor AC Power Quality	
A. Voltage Transients and Surges	_____
B. Voltage Swells and Sags	_____
C. Overvoltage/Undervoltage/Interruptions	_____
D. Frequency Variations	_____
E. Harmonics/Noise/EMI	_____
Session IV. Power System Protection and Conditioning	
A. Filters and Regulators	_____
B. Transformers	_____
C. Surge Protection	_____
D. Voltage Regulation	_____
E. Power Line Conditioners	_____
F. Harmonics and Noise Suppression	_____

Session V. Backup Power; Uninterruptible Power Supplies

- A. Engine-Generator Backup Power Sets
- B. Static Uninterruptible Power Supply
 - 1. Double-Conversion UPS
 - 2. Single-Conversion UPS

Session VI. Direct Current Power

- A. DC Power Supplies
 - 1. Linear Power Supplies
 - 2. Nonlinear Power Supplies
 - 3. Selecting a Power Supply
- B. Laboratory

Have trainees select and test a DC power supply for a given application. This exercise corresponds with Performance Task 1.

- C. Battery and Charger Operation

Session VII. Cable Shielding and Grounding Techniques

- A. Cable Shields
- B. Preventing Ground Loops

Session VIII. Review and Testing

- A. Module Review
- B. 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.

- C. Performance Testing

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