Pipeline E&I Safety – Course Planning Tools

Module 64102-02

MODULE OVERVIEW

This module reviews pipeline safety. Trainees will become familiar with company safety manuals, personal protective equipment, safety tools and regulations, and work-site hazards.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02

OBJECTIVES

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

1. Explain the company safety manual.
2. Describe required personal protective equipment.
3. Describe E&I safety-related tools.
4. Explain safety rules and regulations.
5. Recognize work-site hazards.

PERFORMANCE TASKS

This is a knowledge-based module–there is no performance examination.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils and scratch paper
Module Examinations*
Overhead projector and screen
Whiteboard/chalkboard
Appropriate personal protective equipment
Copies of your company's policy and procedures manual
Copies of a company safety manual (one per group or student)
Various types of safety equipment, including eye, face, and hand protection and respirators
A variety of hot sticks and shotguns
Various tags used in tagouts (new and/or used)
Pictures demonstrating the use of color codes in a pipeline facility
Several MSDSs
Posterboard
Colored markers

* For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

Trade Math
Course Planning Tools

Module 64103-02

MODULE OVERVIEW

This module reviews instrumentation formulas and equations used by E&I technicians working on pipeline operations. Trainees will learn to perform three-phase power and pipeline-specific calculations.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Level One, Module 64102-02

OBJECTIVES

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

1. Solve instrumentation formulas and equations.
2. Perform three-phase power calculations.
3. Perform pipeline-specific calculations.

PERFORMANCE TASKS

This is a knowledge-based module–there is no performance examination.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils and scratch paper
Module Examinations*
Overhead projector and screen
Whiteboard/chalkboard
Appropriate personal protective equipment
Copies of your company's policy and procedures manual
Copies of the *National Electric Code®*, latest edition

* For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

MODULE OVERVIEW

This module reviews the forces of electricity. Topics addressed include conductors and insulators, voltage, and meters. The equations for determining voltage, total current, and resistance are also presented.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Level One, Modules 64102-02 and 64103-02

OBJECTIVES

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

1. Explain the difference between conductors and insulators.
2. Define voltage, current, and resistance, and explain how these properties of electricity are related by performing Ohm's law calculations.
3. Explain the different types of meters used to measure voltage, current, and resistance.
4. Calculate the amount of power used by a circuit using the power formula.
5. Explain the basic characteristics of a series circuit, a parallel circuit, and a series-parallel circuit.
6. Calculate, using Kirchhoff's voltage law and current law, the voltage drop and total current in series, parallel, and series-parallel circuits.
7. Find the total amount of resistance in a series circuit, a parallel circuit, and a series-parallel circuit.

PERFORMANCE TASKS

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

1. Use the formula for Ohm's law to calculate unknown values for current, resistance, and voltage.
2. Given different resistors, identify the correct resistance value and tolerance using the color code.
3. Draw basic voltmeter and ohmmeter circuits and explain how they operate.
4. Use the power formula to calculate the amount of power used by a circuit.
5. Use a variation of the power formula to calculate the maximum current a resistor can carry based on the resistor's value and power rating.
6. Calculate the total resistance for selected series, parallel, and series-parallel circuits.
7. Use Kirchhoff's current law to calculate the total and unknown currents in parallel and series-parallel circuits.
8. Use Kirchhoff's voltage law to calculate voltage drops in series, parallel, and series-parallel circuits.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils and scratch paper
Module Examinations*
Performance Profile Sheets*
Overhead projector and screen
Whiteboard/chalkboard
Appropriate personal protective equipment
Copies of your company's policy and procedures manual
Colored markers (optional)
Posterboard or large sheets of paper (optional)
Various resistors, both wire-wound and carbon (one per trainee)

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.
For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

Tools of the Trade

Module 64105-02

Course Planning Tools

MODULE OVERVIEW

This module reviews the use, care, and maintenance of hand and power tools, test equipment, and communication devices. It also describes more specialized tools used by pipeline electrical and instrumentation technicians.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Level One, Modules 64102-02 through 64104-02

OBJECTIVES

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

1. Use and maintain hand tools.
2. Use and maintain power tools.
3. Use and maintain test equipment.
4. Use and maintain portable communication devices.

PERFORMANCE TASKS

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

1. Identify a given hand tool, state its application, and describe its safe use and maintenance.
2. Demonstrate the use of a given hand tool, according to the standards given by the instructor.
3. Identify a given power tool, state its application, and describe its safe use and maintenance.
4. Demonstrate the use of a given power tool, according to standards given by the instructor.
5. Identify a given kind of test equipment, state its application, and describe its safe use and maintenance.
6. Demonstrate the use of a given kind of test equipment, according to standards given by the instructor.
7. Identify a given kind of portable communication equipment, state its application, and describe its safe use and maintenance.
8. Demonstrate the use of a given kind of portable communication equipment, according to standards given by the instructor.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils/scratch paper
Module Examinations*
Performance Profile Sheets*
Overhead projector and screen
Whiteboard/chalkboard
Appropriate personal protective equipment
Copies of your company's policy and procedures manual
A copy of *National Electrical Code®* (NEC) Articles 345, 346, and 347 or the entire NEC
Benders
Scrap pieces of conduit or electrical metallic tubing
Hickeys (several sizes)
Lengths of conduit (various sizes)
Reamer
Threader
Cable cutters
Scrap pieces of cable
Conduit pistons
Straight wrenches
Stillson wrenches
Electrical wire
Fish tape
Portable band saw
Assorted blades for the band saw
Soldering iron
Tips for the soldering iron
Insulation-resistance tester
RF wattmeter
Frequency counter
Oscilloscope
Precision test gauge
Smart transmitter communicator
Clamp-on ammeter
Breakout box
Digital calibrator
Decade boxes
Signal generator
Typical relay tester
UV/IR guns
IR guns
Matches
Candles
Power quality analyzer
Assorted multimeters
Assorted cell phones, two-way radios, and pagers

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.
For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

Pipeline E&I Drawings
Course Planning Tools

Module 64107-02

MODULE OVERVIEW

This module introduces electrical diagrams, piping and instrumentation diagrams, and pipeline maps and alignment sheets. Trainees will learn how to read and interpret each type.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Level One, Modules 64102-02 through 63106-02

OBJECTIVES

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

1. Explain drawing classifications and written specifications.
2. Read and interpret electrical drawings.
3. Read and interpret piping and instrumentation diagrams.
4. Read and interpret special drawings and diagrams.
5. Read and interpret pipeline maps and alignment sheets.

PERFORMANCE TASKS

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

1. Identify a given type of drawing, state its application, and describe its use.
2. Identify common drawing components, such as the title block, legend, and drafting lines, and describe their use.
3. Read and interpret electrical drawings.
4. Read and interpret piping and instrumentation diagrams.
5. Read and interpret special drawings and diagrams.
6. Read and interpret pipeline maps and alignment sheets.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies

Markers/chalk

Blank acetate sheets

Transparency pens

Pencils and scratch paper

Copies of the Quick Quiz*

Module Examinations**

Performance Profile Sheets**

Overhead projector and screen

Whiteboard/chalkboard

Appropriate personal protective equipment

Copies of your company's policy and procedures manual

Sample elevation views

Copies of drawings with complete title blocks, one copy per trainee

Copies of drawings with complete approval blocks, one copy per trainee

Sample drawings that use the lines listed in *Figures 8* and *9,* one copy per trainee

Rulers (English)

Architect's scales, including triangular scale and flat scale, preferably one per trainee

Engineer's scales, preferably one per trainee

Calculator (optional)

Copies of architectural drawings drawn to scale

Copies of electrical drawings that use a variety of abbreviations and symbols and contain a legend

Copies of a piping and instrumentation diagram that has lines, line numbers, match lines, and piping component symbols, one copy per trainee

Copies of sample instrument location drawings, instrument installation drawings, loop sheets, flow drawings, and instrument data sheets, one of each per trainee

Copies of a survey map, topographic map, profile, and strip map, one of each per trainee

Examples of drawings, some but not all of which are alignment sheets

* Located in the Annotated Instructor's Guide for this module.
** Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.
For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

Understanding the *National Electrical Code*®
Course Planning Tools

Module 64108-02

MODULE OVERVIEW

This module introduces the *National Electrical Code*® (NEC), including its history and purpose. Trainees will become familiar with the content and organization of the NEC and practice using it.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Level One, Modules 64102-02 through 64107-02

OBJECTIVES

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

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

PERFORMANCE TASKS

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

1. Use ***NEC Article 90*** to determine the scope of the NEC, and state what is covered by the NEC and what is not.
2. Find the definition of the term *feeder* in the NEC.
3. Look up the NEC specifications one would need to follow when installing an outlet near a fire pump or water pump house.
4. Find the minimum wire bending space required if two No. 1/0 AWG conductors were to be installed in a junction box or cabinet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils and scratch paper
Module Examinations*
Performance Profile Sheets*
Overhead projector and screen
Whiteboard/chalkboard
Appropriate personal protective equipment
Copies of your company's policy and procedures manual
A copy of the *National Electrical Code®*

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.
For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

Fasteners and Anchors
Course Planning Tools

Module 64109-02

MODULE OVERVIEW

This module reviews threaded and nonthreaded fasteners and anchors. Trainees will learn how to select and install the proper fastener and anchor for each type of job.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Level One, Modules 64102-02 through 64108-02

OBJECTIVES

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

1. Identify and explain the use of threaded, nonthreaded, and special threaded fasteners.
2. Identify and explain the use of anchors.
3. Install fasteners and anchors.

PERFORMANCE TASKS

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

1. From a selection of threaded fasteners, select the correct fastener(s) for one or more applications specified by the instructor.
2. From a selection of nonthreaded fasteners, select the correct fastener for one or more applications specified by the instructor.
3. Install a nut and bolt and torque them to a torque value specified by the instructor.
4. Install a blind rivet using a rivet gun.
5. Drill a hole and install a toggle bolt.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils and scratch paper
Module Examinations*
Performance Profile Sheets*
Overhead projector and screen
Whiteboard/chalkboard
Appropriate personal protective equipment
Copies of your company's policy and procedures manual
Copies of *49 CFR Part 192* (Gas) and/or *49 CFR Part 195* (Liquid)
Assorted threaded fasteners
Samples of the three series of threads
Assorted bolts and screws
Assorted machine screws
Assorted cap screws
Assorted set screws
Assorted concrete/masonry, deck, and drywall screws
Regular and semi-finished nuts
Finished nuts
Jam nut (with standard bolt and nut)
Standard nut (to be installed as jam nut)
Castellated and slotted nuts
A square key, a Pratt and Whitney key, a Gib head key, and a Woodruff key
Shaft keyseat (if separate from keys)
Assorted pin fasteners
Assorted yoke clamps
Assorted spacer clamps
A bundle lock application
A blind rivet application
Thread insert
Assorted washers
Assorted tie wraps
Assorted eye and J-bolts
Hammer-driven pins and studs (and equipment needed to install them)
Powder-actuated tool
Assorted one-step anchors
Equipment for installing each type of one-step anchor
Equipment for installing each type of bolt anchor
Assorted screw anchors
Assorted screw, self-drilling, and hollow-wall anchors
Equipment for installing epoxy anchoring systems
Equipment for installing threaded fasteners
Equipment for installing blind rivets
Equipment for installing toggle bolts
Equipment for a hardened concrete installation (wedge anchors)

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.
For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

Electrical Installations in Classified Areas
Course Planning Tools

Module 64201-02

MODULE OVERVIEW

This module discusses safe work practices for electrical installations in classified areas. Trainees will learn to identify and classify hazardous pipeline areas, to use intrinsically safe devices and systems, and to explain ratings.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Level One

OBJECTIVES

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

1. Explain Class 1 pipeline areas.
2. Describe intrinsically safe devices and systems and explain ratings.
3. Describe allowable conduits and fittings and describe explosion-proof boxes and fixtures.
4. Describe personal protective equipment, and explain how to approach and leave a classified area.

PERFORMANCE TASKS

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

1. Determine if a fitting would be usable in a classified area.
2. Using two rigid metal conduit nipples, a sealing fitting, three pieces of No. 12 THHN conductors, and a packing fiber/sealing kit, perform the following operations:
   - Secure a conduit nipple in each end of the seal.
   - Make sure the required amount of threads are engaged.
   - Pull the three THHN conductors through the nipples and seal so that about 6" are protruding from each nipple.
   - Pack the fiber as per instructions furnished with the sealing kit.
   - Mix the sealing compound.
   - Position the unit in the required location and pour in the sealing compound.
3. Identify a minimum of three different covers for explosion-proof fittings.
4. Remove the inspection cover on an explosion-proof fitting and check for moisture.
5. Install a barrier system.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies

Markers/chalk

Blank acetate sheets

Transparency pens

Pencils and scratch paper

Module Examinations*

Performance Profile Sheets*

Copies of Quick Quiz**

Overhead projector and screen

Whiteboard/chalkboard

Appropriate personal protective equipment

Copies of the National Electrical Code® *Article 504* and/or *ANSI/ISA RP 12.6-1987*

Copies of *49 CFR Part 192* (Gas) and/or *49 CFR Part 195* (Liquid)

Copies of *API Recommended Practice*

Copies of your company policy and procedures manual

Sample documentation for a classified area

Listing of approved equipment and devices from the Underwriters Laboratory or Factory Mutual Research Corporation

Working drawings for an electrical system in a hazardous location

Seal-off fittings for vertical and horizontal runs

Sealing compound kits

Several fittings and a variety of sealing compound kits

Rigid metal conduit nipples, sealing fittings, No.12 THHN conductors, and packing fiber/sealing kit

Samples of a general safe work permit

Samples of damaged protective equipment.

** Located in the Annotated Instructor's Guide for this module.
* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.
For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

Use of Meters and Test Equipment
Course Planning Tools

Module 64202-02

MODULE OVERVIEW

This module identifies the types of meters and test equipment used by E&I technicians to perform maintenance tasks. Trainees will learn to safely use test equipment to measure current, voltage, and resistance.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Level One; Pipeline Electrical and Instrumentation Level Two, Module 64201-02

OBJECTIVES

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

1. Explain general E&I safety, test equipment safety, and the use of personal protective equipment.
2. Explain measuring current using an ammeter and a multimeter.
3. Explain measuring voltage using a voltmeter and a multimeter.
4. Explain measuring resistance using an ohmmeter and a multimeter.
5. Explain specialty electrical and instrumentation test equipment used on pipelines.
6. Explain the use of oscilloscopes to measure waveforms and electrical signals.

PERFORMANCE TASKS

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

1. Use a clamp-on ammeter to measure current.
2. Use an analog or digital multimeter to measure AC/DC voltage, AC/DC current, and resistance.
3. Use a HART digital communicator to configure and calibrate a smart-capable device.
4. Use a calibrator to zero and spin a current-loop device.
5. Use an oscilloscope to measure various waveforms and electrical signals.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils and scratch paper
Module Examinations*
Performance Profile Sheets*
Overhead projector and screen
Whiteboard/chalkboard
Appropriate personal protective equipment
Copies of *49 CFR Part 192* (Gas) and/or *49 CFR Part 195* (Liquid)
Copies of your company policy and procedures manual
Electrical meters and test equipment
Rubber gloves, sleeves, and blankets
A moving-coil meter movement and/or a d'Arsonval meter movement
DC ammeters
Test equipment
Clamp-on ammeters
Digital and analog multimeters
Multimeter batteries and fuses
Voltmeters
Ohmmeters
Megohmmeters
Handheld calibrator
HART communicator
Dead weight testers
Decade box
Analog oscilloscope
A variety of test instruments, including:
- Hi-pot testers
- Recording meters
- Dead weight gauges
- Pneumatic signal simulators
- Fluidized sand baths
- Dry block calibrators
- Continuity testers
- Sound-activated phones

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.
For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.

Grounding
Course Planning Tools

Module 64203-02

MODULE OVERVIEW

This module explains the principles of grounding, proper grounding techniques, and *National Electrical Code*® (NEC) requirements. Trainees will learn to test grounding, measure earth resistance, perform three-point testing, and perform tank grounding.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Pipeline Core, Modules 66101-02 and 66102-02; Pipeline Electrical and Instrumentation Level One; Pipeline Electrical and Instrumentation Level Two, Modules 64201-02 and 64202-02

OBJECTIVES

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

1. Explain the basics of grounding.
2. Explain types of grounding systems.
3. Explain NEC requirements for grounding.
4. Explain equipment grounding.
5. Explain bonding service equipment.
6. Explain effective grounding paths.
7. Explain grounding conductors.
8. Explain separately derived systems.
9. Explain grounding at more than one building.
10. Explain systems over 1,000 volts.
11. Test for effective grounds.
12. Measure earth resistance.
13. Perform three-point testing.
14. Explain tank grounding.

PERFORMANCE TASKS

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

1. Using the proper fittings, connect one end of a No. 4 AWG bare copper grounding wire to a copper ground rod and the other end to the correct terminal in a main panelboard.
2. Measure the resistance of ground electrodes using the fall-of-potential method.
3. Explain and properly terminate an equipment ground.
4. Explain and properly terminate a shield.
5. At an existing installation, point out the bonding between noncurrent-carrying metal parts.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when working with power tools.

PREPARATION

Before teaching this module, you should review the Module Outline, Objectives, Performance Tasks, and the Materials and Equipment List. Be sure to allow ample time to prepare your own training or lesson plan and gather all required equipment and materials.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils and scratch paper
Module Examinations*
Performance Profile Sheets*
Overhead projector and screen
Whiteboard/chalkboard
Calculators
Appropriate personal protective equipment
Copies of *49 CFR Part 192* (Gas) and/or *49 CFR Part 195* (Liquid)
Copies of your company policy and procedures manual
Copies of the 2002 (or latest) edition of the *National Electrical Code®*
Copies of *API Recommended Practices 2003*
Various electrodes that meet the requirements for ground rods
Grounding electrode conductors, No. 4 grounding wire, ground rods, and panelboard
Grounding outlet boxes and devices
Nonmetallic-sheathed cable
Grounding clips
Grounding conductors, grounding wire, and metallic boxes
Earth ground resistance tester
Several ground testers and the necessary test equipment

* Performance Sheets for this module are available from NCCER's Instructor Resource Center at www.nccerirc.com.
For information and updates about accessing the Module Examinations, visit www.nccer.org/testing.