

Lesson Plans for Module AOCFG-17

ABNORMAL OPERATING CONDITIONS – FIELD AND GAS

Module AOCFG-17 describes how field personnel recognize and properly react to abnormal operating conditions (AOCs) that may occur during pipeline operations. Trainees will learn about the federal regulations and agencies governing the operation of gas and liquid pipelines.

Objectives

Learning Objective 1

- Explain how to recognize abnormal operating conditions for both gas and liquid pipelines.
 - a. Explain how to recognize abnormal pipeline facility conditions.
 - b. Explain how to recognize the activation of a safety device.
 - c. Explain how to recognize a communications failure and a control system failure.
 - d. Explain how to recognize power interruptions.
 - e. Explain how to recognize a fire, explosion, and natural disaster occurring in the vicinity of the pipeline.
 - f. Explain how to recognize the unexpected release of hazardous liquid or gas.
 - g. Explain how to recognize unexplained pressure/flow rate changes.

Learning Objective 2

- Describe the proper reaction to abnormal operating conditions for both gas and liquid pipelines.
 - a. Describe the proper reaction to abnormal pipeline facility conditions.
 - b. Describe the proper reaction to the activation of a safety device.
 - c. Describe the proper reaction to a communications failure and a control system failure.
 - d. Describe the proper reaction to power interruptions.
 - e. Describe the proper reaction to a fire, explosion, and natural disaster occurring in the vicinity of the pipeline.
 - f. Describe the proper reaction to the unexpected release of hazardous liquid or gas.
 - g. Describe the proper reaction to unexplained pressure/flow rate changes.

Performance Tasks

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

Teaching Time: 5 hours

(Two 2.5-Hour Classroom Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the PowerPoint presentations from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70 percent or above for the Module Examination.



Safety Considerations

This module does not include Performance Tasks, and as such, no PPE is required for completion of this module. However, trainees should consistently be reminded of all dangers presented by abnormal operating conditions in pipeline work. It should also be stressed that personnel safety is a priority.

Classroom Equipment and Materials

Whiteboard/chalkboard

Markers/chalk

Pencils and paper

PowerPoint® Presentation Slides

Computer

Copies of the Module Examination

Vendor-supplied videos/DVDs showing abnormal operating conditions (*optional*)

TV/DVD player

Additional Resources

The following recommended resources can provide additional helpful information related to the requirements for this covered task:

Code of Federal Regulations 49, Parts 192 and 195

OSHA Occupational Safety and Health Standards 1910, Subpart L, Standard 1910.157.

There are a number of online resources available for trainees who would like more information on abnormal operating conditions. A search for additional information may be assigned as homework to interested trainees.



Lesson Plans for Module AOCCC-17

ABNORMAL OPERATING CONDITIONS – CONTROL CENTER

Module AOCCC-17 describes how control center personnel recognize and properly react to abnormal operating conditions (AOCs) that may occur during pipeline operations. Trainees will learn about the federal regulations and agencies governing the operation of gas and liquid pipelines.

Objectives

Learning Objective 1

- Explain how to recognize abnormal operating conditions in a control center for both gas and liquid pipelines.
 - a. Explain how to recognize abnormal facility conditions and pipeline system damage.
 - b. Explain how to recognize the activation of a safety device.
 - c. Explain how to recognize a communications failure and a control system failure.
 - d. Explain how to recognize power interruptions.
 - e. Explain how to recognize a fire, explosion, and natural disaster occurring in the vicinity of a pipeline.
 - f. Explain how to recognize hazardous liquid or gas encounters.
 - g. Explain how to recognize an unexplained flow rate/pressure change.

Learning Objective 2

- Describe the proper reaction to abnormal operating conditions in a control center for both gas and liquid pipelines.
 - a. Describe the proper reaction to abnormal facility conditions and pipeline system damage.
 - b. Describe the proper reaction to the activation of a safety device.
 - c. Describe the proper reaction to communications failure and a control system failure.
 - d. Describe the proper reaction to power interruptions.
 - e. Describe the proper reaction to a fire, explosion, and natural disaster occurring in the vicinity of a pipeline.
 - f. Describe the proper reaction to hazardous liquid or gas encounters.
 - g. Describe the proper reaction to unexplained flow rate/pressure change.

Performance Tasks

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

Teaching Time: 5 hours

(Two 2.5-Hour Classroom Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the PowerPoint presentations from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70 percent or above for the Module Examination.



Safety Considerations

This module does not include Performance Tasks, and as such, no PPE is required for completion of this module. However, trainees should consistently be reminded of all dangers presented by abnormal operating conditions in pipeline work. It should also be stressed that personnel safety is a priority.

Classroom Equipment and Materials

Whiteboard/chalkboard

Markers/chalk

Pencils and paper

PowerPoint® Presentation Slides

Computer

Copies of the Module Examination

Vendor-supplied videos/DVDs showing abnormal operating conditions (optional)

TV/DVD player

Additional Resources

The following recommended resources can provide additional helpful information related to the requirements for this covered task:

Code of Federal Regulations 49, Parts 192 and 195

OSHA Occupational Safety and Health Standards 1910, Subpart L, Standard 1910.157.

There are a number of online resources available for trainees who would like more information on abnormal operating conditions. A search for additional information may be assigned as homework to interested trainees.

Lesson Plans for Module CT2_1-17

Verify Test Lead Continuity

Module CT2_1-17 discusses test station setup and mounting options, and presents the general procedure used to verify test lead continuity.

Objectives

Learning Objective 1

1. Identify and describe test setups and mounting methods.
 - a. Identify and describe test setups.
 - b. Identify and describe mounting methods.

Learning Objective 2

2. Describe the procedure used to verify test lead continuity (CT2_1-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with verifying test lead continuity.
 - b. Describe the procedure used to verify test lead continuity.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Verify test lead continuity (CT2_1-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Identify the test lead to be tested.
 - Select the proper instrumentation for taking a structure-to-soil reading.
 - Show how to correctly use the instrumentation.
 - Measure structure-to-soil potential and verify that the reading is within the desired range.
 - Confirm that test leads are installed and terminated properly and that test leads are not damaged.
 - If test lead continuity is not found, identify damage if possible and recommend mitigation actions based on readings and visible condition of the test lead.
 - Complete appropriate documentation as required by operator's procedures.
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Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

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Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any deficiencies must be corrected to ensure trainee safety in the future. Work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT2_1-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Test leads
- Multimeter
- Continuity tester
- Reference cell
- Copies of company corrosion prevention procedures
- Copies of the Performance Profile sheets

Lesson Plans for Module CT2_2-17

Repair Damaged Test Leads

Module CT2_2-17 discusses test station setup and mounting options, as well as excavation requirements. It also presents the general procedure used to repair damaged test leads.

Objectives

Learning Objective 1

1. Identify and describe test setups, mounting methods, and belowground test station repair.
 - a. Identify and describe test setups and mounting methods.
 - b. Describe how to perform belowground test station repair.

Learning Objective 2

2. Describe the procedure used to repair damaged test leads (CT2_2-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with repairing damaged test leads.
 - b. Describe the procedure used to repair damaged test leads.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Repair damaged test leads (CT2_2-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Where necessary, make proper notifications to operations and to the local One-Call organization before working around the structure.
 - Identify the test lead damage by performing a visual inspection of the aboveground wire and components.
 - Determine whether the test lead damage can be repaired. If the damage can be repaired, repair the test lead.
 - If the test lead cannot be repaired, connect a replacement to the structure using exothermic or non-exothermic welding. Excavation may be necessary if a structure appurtenance is not available.
 - Verify that the test lead functions properly by obtaining a structure-to-soil potential and/or continuity measurement.
 - If the reading requires further evaluation, seek assistance from appropriate personnel for additional investigative and corrective actions before documentation.
 - Where necessary, make proper notifications to operations that work has been completed.
 - Complete appropriate documentation as required by operator's procedures.
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Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

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Safety Considerations

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Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT2_2-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Sections of pipe for making test lead connections
- Test leads
- Multimeter
- Continuity tester
- Reference cell
- Hand and power tools for cleaning the pipe in preparation for making connections
- Equipment and materials for making mechanical connections (magnetic, epoxy, split bolt, and inline)
- Copper wire, soldering iron, sponge, water, tinning paste, and solder
- Pin brazing unit and pins
- Exothermic welding setup with appropriate powder charge
- Copies of the Performance Profile sheets

Lesson Plans for Module CT2_3-17

Install Test Leads by Non-Exothermic Welding Methods

Module CT2_3-17 discusses test station setup and mounting options, and it presents the general procedures for installing test leads using non-exothermic welding methods.

Objectives

Learning Objective 1

1. Identify and describe test setups, mounting methods, and mechanical bonding methods.
 - a. Identify and describe test setups and mounting methods.
 - b. Identify and describe mechanical bonding methods.

Learning Objective 2

2. Describe the procedure used install test leads using non-exothermic welding methods (CT2_3-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with installing test leads using non-exothermic welding methods.
 - b. Describe the procedure used to install mechanical bonds.
 - c. Describe the procedure used to insulate a butt-spliced crimp connection.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Install test leads using non-exothermic welding methods (CT2_3-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Determine the number of wires needed and the size of wire to be used.
 - Determine the method to attach the wire to the pipeline or facility.
 - Remove the existing coating at the site where the wire is to be installed.
 - Prepare the surface for the wire installation and install the wires to the structure.
 - Repair the coating.
 - Extend the wire.
 - Complete appropriate documentation as required by operator's procedures.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

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Safety Considerations

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Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT2_3-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Sections of pipe for making test lead connections
- Test leads
- Multimeter
- Continuity tester
- Reference cell
- Hand and power tools for cleaning the pipe in preparation for making connections
- Equipment and materials for making mechanical connections (magnetic, epoxy, split bolt, and inline)
- Copies of the Performance Profile sheets

Lesson Plans for Module CT2_4-17

Install Test Leads by Exothermic Welding Methods

Module CT2_4-15 discusses test station setup and mounting options, and it presents the general procedures for installing test leads using exothermic welding methods.

Objectives

Learning Objective 1

1. Identify and describe test setups, mounting methods, and exothermic welding methods.
 - a. Identify and describe test setups and mounting methods.
 - b. Identify and describe soldering, brazing, and exothermic welding methods.

Learning Objective 2

2. Describe the procedure used install test leads by exothermic welding methods (CT2_4-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with installing test leads by exothermic welding methods.
 - b. Describe the procedure for making exothermic welds and solder connections.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Install test leads by exothermic welding methods (CT2_4-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Verify the nominal wall thickness.
 - Remove a window of paint or coating from the section of pipe to be welded and prepare the pipe to shiny bare metal.
 - Strip 1" of insulation from the wire and, if necessary, crimp the copper sleeve to the bare wire.
 - Place metal disc cone side down at the bottom of the graphite mold. Pour contents of metal powder on top of the disc. Ensure that starting powder lies on top of the metal powder when pouring.
 - Place the graphite cover on top of the graphite mold and place the graphite mold on the desired location to be welded. Apply the spark gun to the graphite cover and away from the operator.
 - Carefully remove slag with a hammer and wire brush. File sharp edges off the top of the exothermic weld.
 - Thoroughly clean the area to be coated with a wire brush. Prime the cleaned surface.
 - Complete appropriate documentation as required by operator's procedures.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

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Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any deficiencies must be corrected to ensure trainee safety in the future. Work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT2_4 -17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Sections of pipe for making test lead connections
- Test leads
- Multimeter
- Continuity tester
- Reference cell
- Hand and power tools for cleaning the pipe in preparation for making connections
- Copper wire, soldering iron, sponge, water, tinning paste, and solder
- Pin brazing unit and pins
- Exothermic welding setup with appropriate powder charge
- Copies of the Performance Profile sheets

Lesson Plans for Module CT3_0-17

Obtain a Voltage and Current Output Reading from a Rectifier to Verify Proper Performance

Module CT3_0-17 describes how to make voltage measurements on a rectifier, and it explains how to calculate current using a shunt factor and voltage measurements.

Objectives

Learning Objective 1

1. Identify test instruments used in the maintenance of cathodic protection systems and describe how to make voltage measurements from a rectifier and calculate current.
 - a. Identify test instruments used in the maintenance of cathodic protection systems.
 - b. Describe how to make voltage measurements from a rectifier and calculate current.

Learning Objective 2

2. Obtain voltage and current output readings from a rectifier to verify proper performance (CT3_0-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with obtaining voltage and current output readings from a rectifier.
 - b. Describe the procedures for obtaining voltage and current output readings from a rectifier.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Obtain voltage and current output readings from a rectifier to verify proper performance (CT3_0-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Identify the rectifier.
 - Determine the voltage by connecting a voltmeter across the output terminals of the rectifier.
 - Obtain the shunt factor by reading the value labeled on the shunt and dividing the amp value by the millivolt (mV) value.
 - Determine the current on a pre-installed shunt by reading the millivolt (mV) drop across the shunt and multiplying by the shunt factor.
 - Check voltage and current readings against display meters and/or remote monitoring devices, if applicable.
 - Complete appropriate documentation as required by operator's procedures.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the Module Examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any deficiencies must be corrected to ensure trainee safety in the future. Work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT3_0-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Access to an operating rectifier for monitoring and adjustment
- Meters capable of making DC measurements (multimeter or voltmeter and ammeter)
- Copies of the Performance Profile sheets

Lesson Plans for Module CT4_1-17

Troubleshoot Rectifier

Module CT4_1-17 reviews the function and components of a rectifier used for cathodic protection and describes the procedures for troubleshooting rectifiers.

Objectives

Learning Objective 1

1. Describe rectifiers.
 - a. Identify the components in a rectifier system.

Learning Objective 2

2. Troubleshoot rectifiers (CT4_1-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with troubleshooting rectifiers.
 - b. Describe the procedures for troubleshooting rectifiers.

Performance Task

Performance Task (Learning Objective 2)

1. Troubleshoot rectifiers (CT4_1-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - On the primary AC breaker and with power on, check that voltage is being supplied to the rectifier by confirming AC voltage on the line side of the rectifier's circuit breaker.
 - Remove the primary AC fuses or breakers and check for continuity with ohmmeter.
 - On the transformer and with the unit on, check the transformer secondary by reading AC voltage between the center studs of the tap setting terminals.
 - Remove secondary AC fuses and check for continuity with ohmmeter.
 - Check the resistance of the diodes in a stack.
 - On DC fuses, remove fuse or fuses and check for continuity using an ohmmeter. Replace defective fuse or fuses with proper size fuse.
 - On bonds, measure the pipe-to-soil potential at the major bond for the company pipeline structure, and measure and record the magnitude and direction of current flow through the bond.
 - If the rectifier requires further evaluation due to abnormal defects or needs adjusting seek assistance from appropriate personnel for additional investigative and corrective actions before making any adjustments.
 - Complete appropriate documentation as required by operator's procedures.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the Module Examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any work performed on or in the vicinity of functioning equipment must be completed under your direct supervision.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT4_1-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Rectifier or photos of a rectifier
- Various types of circuit breakers
- Rectifying cells
- Specific PPE required by the site
- Various types of circuit breakers
- Multimeter
- Copies of field data sheets for recording measurements
- Copies of the Performance Profile sheets

Lesson Plans for Module CT4_2-17

Repair or Replace Defective Rectifier Components

Module CT4_2-17 reviews the function and components of rectifiers used for cathodic protection, and it describes the general procedures used to repair or replace defective rectifier components.

Objectives

Learning Objective 1

1. Describe rectifiers.
 - a. Identify the components in a rectifier system.

Learning Objective 2

2. Repair or replace rectifier components (CT4_2-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with repairing or replacing rectifier components.
 - b. Describe the procedures for repairing or replacing rectifier components.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Repair or replace defective rectifier components (CT4_2-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Prior to performing any of the following steps, turn off the external AC supply to the rectifier.
 - Complete the following on the primary AC breaker:
 - Disconnect wires from the supply to the breaker.
 - Disconnect wires from the breaker to the rectifier.
 - Replace defective breaker with a new breaker.
 - Connect wires from the breaker to the rectifier.
 - Connect wires from the AC supply to the breaker.
 - Complete the following on primary AC fuses:
 - Remove fuse or fuses.
 - Replace defective fuse or fuses with proper size fuse(s).
 - Complete the following on the transformer:
 - Disconnect wires from the rectifier AC breaker to the transformer.
 - Disconnect wires from the transformer to the coarse and fine tap panels.
 - Replace defective transformer with a new transformer.
 - Connect wires from the transformer to the coarse and fine tap panel.
 - Connect wires from the transformer to the AC rectifier breaker.
 - Complete the following on the stack:
 - Disconnect wires from the fine and coarse tap panel to the stack.
 - Disconnect wires from the stack to the positive and negative DC output terminals.
 - If the stack is selenium, remove the stack and replace with a new stack.
 - If the stack is silicon, remove the defective diodes and replace them with new diodes.
 - Connect wires from the stack to the positive and negative DC output terminals.
 - Connect wires from the fine and coarse tap panel to the stack.

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- Complete the following on DC fuses:
 - Remove fuse or fuses.
 - Replace defective fuse or fuses with proper size fuse(s).
 - Examine the rectifier for any abnormal defects. Does the rectifier need adjusting? If so, seek assistance from appropriate personnel for additional investigation and corrective actions before making any adjustments.
 - Complete appropriate documentation as required by operator's procedures.
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Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

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Safety Considerations

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Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT4_2-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- AC circuit breakers
- AC and DC fuses
- A rectifier, or photos of a rectifier
- Rectifying cells
- Multimeter
- Transformer
- Tools for making wiring terminations
- Rectifier stack/silicon diodes
- Copies of field data sheets for recording measurements
- Copies of the Performance Profile sheets

Lesson Plans for Module CT4_3-17

Adjustment of Rectifier

Module CT4_3-17 describes the function and components of a rectifier used for cathodic protection. It also explains the general procedure for adjusting the output of a rectifier after components have been repaired or replaced.

Objectives

Learning Objective 1

1. Describe rectifiers.
 - a. Identify the components in a rectifier system.

Learning Objective 2

2. Adjust a rectifier (CT4_3-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with adjusting a rectifier.
 - b. Describe the procedure for adjusting a rectifier.

Performance Task

Performance Task (Learning Objective 2)

1. Adjust a rectifier (CT4_3-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Remove power from the rectifier and increase the fine tap setting in progressive steps until desired settings have been achieved. If the fine tap setting reaches its highest setting, set the fine tap to the lowest setting and increase the coarse tap setting by one.
 - Determine voltage by connecting a suitable digital voltmeter across the output terminals of the rectifier.
 - Determine current on a pre-installed shunt by reading the millivolt drop across the shunt and multiplying by the shunt ratio.
 - Adjust rectifier panel meters to match readings obtained with a portable meter. Measure structure-to-electrolyte potential to ensure that polarity on the pipe is correct and the pipe-to-soil potential is in the desired range.
 - If the rectifier requires further evaluation due to abnormal defects or needs adjusting, seek assistance from appropriate personnel for additional investigation and corrective actions before making any adjustments.
 - Complete appropriate documentation as required by operator's procedures.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the Module Examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any deficiencies must be corrected to ensure trainee safety in the future. Work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT4_3-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Photos of a rectifier or access to a rectifier
- Examples of circuit breakers
- Examples of rectifying cells
- Multimeter
- Megohmmeter
- Electronic control card
- Copies of field data sheets for recording measurements
- Copies of the Performance Profile sheets

Lesson Plan for Module CT5_1-17

Examining for Mechanical Damage on Buried or Submerged Pipe

Module CT5_1-17 reviews common types of pipe coatings and discusses the steps used to inspect buried and submerged pipe for mechanical damage when the pipe is exposed.

Objectives

Learning Objective 1

1. Identify types of damage and understand the use of coatings on buried or submerged pipe.
 - a. Identify the different types of damage and corrosion found on buried or submerged pipelines.
 - b. Identify and describe common types of coatings used on buried or submerged pipe.
 - c. Describe the importance of proper coating selection on buried and submerged pipe.
 - d. Describe how to indicate pipe orientation.

Learning Objective 2

2. Describe how to examine buried or submerged pipe for mechanical damage when the pipe has been exposed (CT5_1-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with examining buried or submerged pipe for mechanical damage when the pipe has been exposed.
 - b. Describe the procedure for visually inspecting a buried or submerged pipe for mechanical damage when the pipe has been exposed.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Examine buried or submerged pipe for mechanical damage (CT5_1-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Visually observe the exposed pipe for integrity issues such as evidence of a release or significant metal deformation. If unsafe integrity issues are identified, discontinue the task and make immediate notifications.
 - Confirm that the pipeline surface has been prepared for the mechanical damage inspection.
 - Inspect the exposed pipeline to determine if mechanical damage exists. Identify the type(s) and location(s) of mechanical damage.
 - Complete appropriate documentation as required by operator's procedures, and make required notifications.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing. Using your access code, download the written examinations and Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the written examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT5_1-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Access to an exposed pipeline for inspection
- Compass
- Standard pit gauge
- Copies of pipeline inspection form/field corrosion report
- Copies of the Performance Profile sheets

Lesson Plans for Module CT5_2-17

Examining for External Corrosion on Buried or Submerged Pipe

Module CT5_2-17 reviews the types of pit gauges and how to use them to measure the remaining wall thickness of a pipe. It also discusses the steps used to inspect the exterior and interior of buried or submerged pipe for corrosion when the pipe has been exposed.

Objectives

Learning Objective 1

1. Identify types of damage and understand the use of coatings on buried or submerged pipe.
 - a. Identify the different types of damage and corrosion found on buried or submerged pipelines.
 - b. Identify and describe common types of coatings used on buried or submerged pipe.
 - c. Describe the importance of proper coating selection on buried or submerged pipe.
 - d. Describe how to indicate pipe orientation.

Learning Objective 2

2. Describe the use of a pit gauge to determine the remaining wall thickness of a pipe.
 - a. Identify and describe common types of pit gauges.
 - b. Describe how to measure pit depth and length with a pit gauge and gather remaining wall strength (RSTRENG) data.

Learning Objective 3

3. Describe how to examine buried or submerged pipe for external corrosion when the pipe is exposed (CT5_2-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with examining buried or submerged pipe for external corrosion.
 - b. Describe the procedures for inspecting the exterior and interior of buried or submerged pipe for corrosion when the pipe is exposed.

Performance Task

Performance Task 1 (Learning Objective 3)

1. Examine buried or submerged pipe for external corrosion (CT5_2-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Visually observe the exposed pipe for evidence of integrity issues (such as metal deformation or evidence of a release), and confirm that the pipeline surface has been prepared for inspection.
 - Examine the exposed pipe for any areas of external corrosion.
 - Identify the type(s) and location(s) of any corrosion found, and record your findings.
 - Measure the longitudinal axis of the corroded area(s) to determine the length. Measure the depth of the pit(s) using a pit depth gauge. Note the location of the corroded area of the pipe (top, bottom, or sides). Record all information according to company policies and procedures.
 - Complete appropriate documentation as required by operator's procedures.
-

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the written examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

Whiteboard and markers	Copies of the Module Examinations (for paper-based exams)
Pencils and paper	Access to an exposed pipeline for inspection
CT5_2-17 PowerPoint® Presentation Slides	Compass
DVD player	Standard pit gauge
LCD projector and screen	Copies of pipeline inspection form/field corrosion report
Computer	Copies of the Performance Profile sheets
Internet access during class (optional)	
Module Examinations answer key	

Lesson Plan for Module CT5_3-17

Inspect the Condition of External Coating on Buried or Submerged Pipe

Module CT5_3-17 reviews various types of coating failures and discusses the steps used to inspect the condition of the external coating on buried and submerged pipe.

Objectives

Learning Objective 1

1. Identify various types of external coatings, coating failures, and causes of coating failures on buried or submerged pipe.
 - a. Identify and describe the types of coatings used on buried or submerged pipe.
 - b. Identify various types of external coating failures on buried or submerged pipe and describe their causes.
 - c. Identify different methods of applying external coatings.
 - d. Describe how to indicate pipe orientation.

Learning Objective 2

2. Describe how to inspect the condition of the external coating on buried or submerged pipe (CT5_3-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with inspecting the condition of the external coating on buried or submerged pipe.
 - b. Describe the procedure for inspecting the condition of the external coating on buried or submerged pipe.

Performance Tasks

Performance Task 1 (Learning Objective 2)

1. Inspect the condition of the external coating on buried or submerged pipe (CT5_3-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Visually observe the exposed pipe for integrity issues such as evidence of a release or significant metal deformation. If unsafe integrity issues are identified, discontinue the task and make immediate notifications.
 - Identify the type of existing coating.
 - Identify any flaws/abnormalities in the coating.
 - Identify the type and location of coating damage, if any.
 - Complete the appropriate documentation and make notifications as required by operator's procedures.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the written examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT5_3-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Examinations
- Access to an exposed pipeline for inspection
- Compass
- Standard pit gauge
- Bridge for measuring uneven surfaces
- Grease pencil for marking pipe
- Appropriate solvent (with safety data sheet) and cotton rags for removing hydrocarbon residue
- Sterile swab or tongue depressor to remove sample material at the bottom of pits/wall loss
- Serial dilution kit for bacterial testing
- Sample containers, labels, and plastic wrap
- Pocket knife
- Ruler
- Tape measure
- Digital camera
- Copies of a pipeline inspection form/field corrosion report
- Copies of the Performance Profile sheets

Lesson Plans for Module CT7_1-17

Visual Inspection of Atmospheric Coatings

Module CT7_1-17 describes standards and procedures involved in the visual inspection of atmospheric coatings on a pipeline system.

Objectives

Learning Objective 1

1. Describe factors and standards that relate to pipeline coatings.
 - a. Identify surface preparation standards.
 - b. Identify inspection standards.

Learning Objective 2

2. Describe how to visually inspect atmospheric coatings (CT7_1-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with visually inspecting atmospheric coatings.
 - b. Describe the procedures used to inspect above-ground, normally exposed components.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Visually inspect atmospheric coatings (CT7_1-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Confirm the correct location for inspection.
 - Identify and confirm type of surface to be evaluated (coating/paint/bare).
 - Perform visual inspection of coating.
 - Inspect pipeline components for any atmospheric corrosion (rust, spotting, pin point, pitting, or perforation)
 - Determine overall pipeline component condition.
 - Complete appropriate documentation as required by operator's procedures.
-

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the Module Examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any deficiencies must be corrected to ensure trainee safety in the future. Work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT7_1-17 PowerPoint® presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Profile comparator
- Profile gauge
- Replica tape
- Surface temperature gauge
- Sling psychrometer
- Adhesion testing equipment
- Sections of coated pipe and/or pipeline components
- Any applicable tools that may be required to perform the inspection
- Copies of a pipeline inspection form/field corrosion report
- Copies of the Performance Profile sheets

Lesson Plans for Module CT7_2-17

Prepare Surface for Coating Using Hand and Power Tools

Module CT7_2-17 reviews established standards for surface cleaning and preparation, examines hand tools and power tools that are commonly used to prepare a surface, and describes the procedures for cleaning and preparing a surface for coating using hand tools and power tools.

Objectives

Learning Objective 1

1. Describe standards and equipment related to cleaning and preparing a surface with hand and power tools.
 - a. Describe hand tools used to clean and prepare a surface for coating.
 - b. Describe power tools and chemical strippers used to clean and prepare a surface for coating.

Learning Objective 2

2. Describe how to prepare a surface for coating using hand and power tools (CT7_2-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with preparing a surface for coating using hand and power tools.
 - b. Describe the procedures used to prepare a surface for coating using hand and power tools.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Prepare a surface for coating using hand and power tools (CT7_2-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Visually inspect the surface to be prepared.
 - Identify the proper steps and tools for cleaning and surface preparation.
 - Remove contaminants from specified area, if present.
 - Remove existing coating, if present.
 - Ensure that the surface preparation meets company standards or specifications.
 - Complete appropriate documentation as required by operator's procedures.
-

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the Module Examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any deficiencies must be corrected to ensure trainee safety in the future. Work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

Whiteboard and markers
Pencils and paper
CT7_2-17 PowerPoint® Presentation
DVD player
LCD projector and screen
Computer
Internet access during class (optional)
Module Review answer key
Module Examinations
Specific PPE required by the site
Sections of coated pipe
Examples of each class of chemical stripper
Various hand tools for cleaning and preparing a surface, including:
 Abrasive pads
 Sandpaper
 Scrapers
 Putty knives
 Combination tools
 Wire brushes
 Chipping hammers

Various power tools for cleaning and preparing a surface, including:
 Grinders
 Sanders
 Grinder and sander attachments
 Power wire brushes
 Power files
 Needle guns
 Chipping and scaling hammers
 Piston scalers
 Power chisels
 Rotary impact tools
 Abrasive hubs
 Vacuum shroud or a power tool equipped with a vacuum shroud
Any applicable hand and power tools that may be required to perform the surface cleaning and preparation
Copies of a pipeline inspection form/field corrosion report
Copies of the Performance Profile sheets

Lesson Plans for Module CT7_3-17

Prepare Surface for Coating by Abrasive Water Blasting

Module CT7_3-17 describes cleaning compounds and low-pressure water cleaning equipment, and explains the procedures for cleaning and preparing a surface for coating using abrasive water blasting.

Objectives

Learning Objective 1

1. Identify and describe cleaning compounds and low-pressure water cleaning equipment that can be used to prepare a surface for coating.
 - a. Identify and describe solvents and detergents that can be used to wash a surface.
 - b. Describe low-pressure water cleaning equipment that can be used to wash a surface.

Learning Objective 2

2. Describe how to prepare a surface for coating by abrasive water blasting (CT7_3-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with preparing a surface for coating using abrasive water blasting.
 - b. Describe the procedures for cleaning a surface using abrasive water blasting.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Prepare a surface for coating by abrasive water blasting (CT7_3-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Locate area to be abrasive water blasted.
 - Set up equipment logistics per job requirements.
 - Visually inspect the surface area for contaminants prior to blasting.
 - Remove contaminants from specified area, if present.
 - Remove existing coating or mill scale, rust, weld slag, etc., to achieve profile.
 - Ensure that the surface preparation meets company standards or specifications.
 - Complete appropriate documentation as required by operator's procedures.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the Module Examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any deficiencies must be corrected to ensure trainee safety in the future. Work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

Whiteboard and markers	A low-pressure, cold water pressure washer
Pencils and paper	One or more examples of each of the
CT7_3-17 PowerPoint® Presentation	following types of blaster tips:
DVD player	0-degree
LCD projector and screen	15-degree
Computer	25-degree
Internet access during class (optional)	40-degree
Module Review answer key	Any of the following accessories:
Module Examinations	Chemical in-line injector
Specific PPE required by the site	Rotary power scrub brush
Sections of coated pipe	Telescoping extension
Hydrocarbon-based solvents	Horizontal scrubber with rotating nozzle
Industrial alkaline cleaners	Variable tip nozzle
Appropriate abrasives for the surface being prepared and the blast equipment being used	Rotatable tip nozzle
Rust inhibitors	Wet abrasive injector
Appropriate abrasive loading/recovery equipment or abrasive cleaning/recycling system	One or more quick-disconnect couplers and nozzles
Containment, as required	Copies of a pipeline inspection form/field corrosion report
	Copies of the Performance Profile sheets

Lesson Plans for Module CT7_4-17

Prepare Surface for Coating by Abrasive Blasting Media Other Than Water

Module CT7_4-17 reviews standards that pertain to surface preparation and profiling, covers safety issues related to the use of abrasive blasting, and describes various types of abrasives and blasting equipment. It also explains the general procedures for cleaning and preparing a surface using abrasive blasting media.

Objectives

Learning Objective 1

1. Describe standards and equipment related to preparing a surface for coating using abrasive blasting other than water.
 - a. Identify and describe preparation standards, surface profiling, and abrasives.
 - b. Describe abrasive blasting equipment and operations.

Learning Objective 2

2. Describe how to prepare a surface for coating by abrasive blasting media other than water (CT7_4-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with preparing a surface for coating using abrasive blasting media other than water.
 - b. Describe the procedures for preparing a surface for coating using abrasive blasting media other than water.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Prepare surface for coating by abrasive blasting other than water (CT7_4-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Identify the area to be abrasive blasted.
 - Set up equipment logistics per job requirements.
 - Visually inspect the surface area for contaminants prior to blasting.
 - Using appropriate personal protective equipment, remove contaminants from specified area, if present.
 - Using abrasive blasting equipment and media other than water, remove existing coating (or mill scale, rust, weld slag, etc.) to achieve specified or required profile.
 - Ensure that the surface preparation meets the operator's standards or specifications, and notify the proper inspection personnel.
 - Complete appropriate documentation as required by operator's procedures.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the Module Examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any deficiencies must be corrected to ensure trainee safety in the future. Work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT7_4-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Sections of coated pipe
- Applicable abrasive blast cleaning equipment and abrasives
- Appropriate abrasives for the surface being prepared and the blast equipment being used
- Rust inhibitor, if required
- Profile comparator, profile gauge, or replica tape with a spring micrometer
- Appropriate abrasive loading/recovery equipment or abrasive cleaning/recycling system
- Containment, as required
- One or more of the following types of blast cleaning systems:
 - Typical medium-size, high production blast system with pneumatic blast machine controls, separate breathing air compressor, and loading/recovery/recycling equipment
 - Sodium bicarbonate blasting system
 - Abrasive sponge blasting system
 - Carbon dioxide blasting system
 - Ice blasting system
- Copies of a pipeline inspection form/field corrosion report
- Copies of the Performance Profile sheets

Lesson Plans for Module CT7_5-17

Apply Coating Using Hand Application Methods

Module CT7_5-17 explains some of the basic preparations and materials for applying coatings by hand, and it describes the general procedure for applying coatings using hand application methods.

Objectives

Learning Objective 1

1. Describe basic preparations that should be done before applying coatings using hand application methods.
 - a. Describe environmental considerations and coating selection and mixing.
 - b. Describe brush and roller selection and use.

Learning Objective 2

2. Describe how to apply coating using hand application methods (CT7_5-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with applying coatings using hand application methods.
 - b. Describe the procedure for applying coatings using hand application methods.

Performance Tasks

Performance Task 1 (Learning Objective 2)

1. Apply coating using hand application methods (CT7_5-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Determine what type of coating is applicable to the specified pipeline component.
 - Assemble the tools and equipment necessary for application as required by coating specification.
 - Follow applicable coating specification.
 - Prepare coating for application.
 - Ensure that weather conditions are suitable for coating operations.
 - Apply per coating specification.
 - Complete appropriate documentation as required by operator's procedures.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the Module Examination; performance testing is graded pass or fail.

Safety Considerations

This module requires that trainees work with pipeline systems carrying hazardous liquids under high pressure. Safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to unseen hazards related to starting up a pipeline. Any deficiencies must be corrected to ensure trainee safety in the future. All practice sessions and Performance Tasks must be completed under your direct supervision.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT7_5-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Sections of pipe prepared for coating
- Proper containment as required by the work site
 - (including handheld shields, masking or covering adjacent surfaces)
- Coating materials, plus primer, intermediate coating, and thinner, as required
- Tools for mixing and preparing the coating
 - (manual or mechanical mixing, boxing, straining, thinning, catalyzing)
- Appropriate brushes and rollers for the coating and the surface
- Roller accessories (roller covers, trays, grids, extension poles)
- Materials such as Kraft paper or scrap dry wall for breaking in roller covers
- Cleaning supplies for cleaning brushes and rollers, including:
 - Solvents and detergents
 - Buckets, pails
 - Lidded containers for collecting used solvent waste
 - Brush spinners and roller spinners
- Wrapping materials in which to store clean, dry brushes
- Copies of a pipeline inspection form/field corrosion report
- Copies of the Performance Profile sheets

Lesson Plans for Module CT7_6-17

Apply Coating Using Spray Application

Module CT7_6-17 describes protective equipment and safe work practices associated with spray application systems. It explains how to prepare coating materials and operate various types of spray system equipment. The general procedure for applying coatings using spray application methods is also presented.

Objectives

Learning Objective 1

1. Describe basic preparations that should be done before applying coatings using spray application methods.
 - a. Describe safety-related considerations and coating selection and mixing.
 - b. Describe common spray system equipment and operation.

Learning Objective 2

2. Describe how to apply coatings using spray application (CT7_6-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with applying coatings using spray application methods.
 - b. Describe the procedure for applying coatings using spray application methods.

Performance Tasks

Performance Task 1 (Learning Objective 2)

1. Apply coatings using spray application methods (CT7_6-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Determine what type of coating is applicable to the specified pipeline component.
 - Assemble the tools and equipment necessary for application as required by coating specification.
 - Follow applicable coating specification.
 - Prepare coating for application.
 - Ensure that weather conditions are suitable for coating operations.
 - Apply per coating specification.
 - Complete appropriate documentation as required by operator's procedures.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the Module Examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any deficiencies must be corrected to ensure trainee safety in the future. Work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT7_6-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Examples of different nozzle combinations
- Examples of new spray gun tips and worn spray gun tips
- Sections of pipe prepared for coating
- Proper containment as required by the work site
 - (including handheld shields, masking or covering adjacent surfaces)
- Coating materials, plus primer, intermediate coating, and thinner, as required
- Tools for mixing and preparing the coating, including Zahn viscosity cups, coating thermometers, and equipment for hand, mechanical, or electronic proportioning
- Equipment for one or more of the following spray application methods:
 - Conventional air spray system (pressure feed or siphon feed)
 - Airless spray system
 - Air-assisted airless spray system
 - HVLP spray system
- Proper disposal equipment for used solvent and dry waste
- Appropriate cleaning equipment in accordance with state/local regulations
- Copies of a pipeline inspection form/field corrosion report
- Copies of the Performance Profile sheets

Lesson Plans for Module CT7_7-17

Perform Coating Inspection

Module CT7_7-17 describes common checks and inspections that must be performed before, during, and after the application of pipeline coatings. It also explains the general procedure for performing a coating inspection.

Objectives

Learning Objective 1

1. Identify and describe checks and inspections that must be performed before, during, and after coating applications.
 - a. Describe ambient conditions and surface preparation conditions that must be checked before a coating application.
 - b. Describe inspections and tests that must be performed on coatings.

Learning Objective 2

2. Describe how to perform a coating inspection (CT7_7-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with coating inspections.
 - b. Describe the procedure for performing a coating inspection.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Perform a coating inspection (CT7_7-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Complete weather and surface temperature testing using a sling psychrometer, surface temperature indicator, and ambient temperature gauge.
 - Verify the surface profile is met pursuant to the coating specification.
 - After the coating is applied, conduct the following test(s) in accordance with the coating specification, as applicable:
 - Wet film test
 - Dry film test
 - Pinhole/holiday test
 - Adhesion test
 - Tooke test
 - Barcol hardness test
 - Complete appropriate documentation as required by operator's procedures.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the Module Examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any deficiencies must be corrected to ensure trainee safety in the future. Work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT7_7-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Sections of pipe prepared for coating or already coated
- Preprinted forms for documenting QA/QC and inspection tasks
- Proper containment as required by the work site (including handheld shields, masking or covering adjacent surfaces)
- Tools for checking ambient conditions and surface temperatures, including:
 - Sling psychrometer
 - Battery-operated psychrometer
 - Electronic thermometer/hygrometer
 - Bimetallic (surface temperature) thermometer
 - Wind meter (anemometer)

- Tools for checking surface profile, including:
 - Surface profile comparator
 - Replica tape with spring micrometer
 - Profile depth gauge
- Tools for checking coating conditions, including:
 - Wet film thickness gauge
 - Dry film thickness gauge
 - Barcol impressor
 - Magnetic pull-off gauge
 - Electronic magnetic flux constant pressure probe
 - Constant pressure probe (eddy current)
 - Low-voltage holiday (wet sponge) detector
 - Direct current high-voltage detector
 - Alternating current electrostatic detector
 - Pneumatic adhesion tester
 - Mechanical adhesion tester
 - Hydraulic adhesion tester
 - Tooke (destructive film thickness) gauge
- Copies of a pipeline inspection form/field corrosion report
- Copies of the Performance Profile sheets

Lesson Plans for Module CT12_0-17

Visually Inspect Internal Pipe Surface

Module CT12_0-17 explains how to determine pipe orientation, and describes the general procedure for the internal inspection of a pipe for evidence of corrosion and other damage.

Objectives

Learning Objective 1

1. Describe the requirements and procedures for the visual inspection of internal pipe surfaces.
 - a. Describe how to indicate pipe orientation.
 - b. Explain how to visually inspect the internal pipe surface for corrosion and damage.

Learning Objective 2

2. Describe how to visually inspect internal pipe surfaces (CT12_0-17).
 - a. Identify the prerequisites, competencies, and abnormal operating conditions associated with the visual inspection of pipe surfaces.
 - b. Describe the procedure for visual inspection of an internal pipe surface.

Performance Task

Performance Task 1 (Learning Objective 2)

1. Visually inspect internal pipe surfaces (CT12_0-17).
 - Identify potential abnormal operating conditions that may occur during performance of this CT, and know the appropriate actions to take in response to them.
 - Utilize the appropriate personal protective equipment according to relevant company procedures.
 - Confirm that pipe is in a condition to allow an internal inspection and, if removed, that orientation has been properly marked. Mark both the removed section and the upstream/downstream pipe according to operator's procedures.
 - Record the initial visual inspection of the inside of the pipe.
 - Remove any hydrocarbon residue by using an approved solvent or mechanical means.
 - Record the visual inspection of the inside of the pipe after cleaning.
 - Measure for internal wall loss.
 - Transport and store the pipe sample.
 - Complete appropriate documentation as required by operator's procedures.

Teaching Time: 5 hours

(Two 2.5-Hour Sessions)

Session time and quantity may be adjusted to accommodate your class size, schedule, and teaching style.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Performance Profile Sheets from www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the Module Examination; performance testing is graded pass or fail.

Safety Considerations

This module may require trainees to work in the vicinity of functioning equipment. Electrical and mechanical safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and remain aware of any potential abnormal operating conditions. Any deficiencies must be corrected to ensure trainee safety in the future. Work performed on or in the vicinity of functioning equipment must be completed under the direct supervision of the instructor.

Equipment, Materials, and Resources

- Whiteboard and markers
- Pencils and paper
- CT12_0-17 PowerPoint® Presentation
- DVD player
- LCD projector and screen
- Computer
- Internet access during class (optional)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Access to an open pipeline for inspection
- Compass
- Grease pencil for marking pipe
- Appropriate solvent (with safety data sheet) and cotton rags for removing hydrocarbon residue
- Sterile swab or tongue depressor to remove sample material at the bottom of pits/wall loss
- Serial dilution kit for bacterial testing
- Sample containers, labels, and plastic wrap
- Pocket knife
- Ruler
- Tape measure
- Digital camera
- Copies of a pipeline inspection form/field corrosion report
- Copies of the Performance Profile sheets