

# 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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://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 CT25\_1-17

## Inspect, Test, and Calibrate Pressure Switches

**Module CT25\_1-17** presents skills and knowledge for inspecting, testing, and calibrating pressure switches in pipelines. Pressure switches are common equipment related to process control, and their correct function is critical to pipeline operation.

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### Objectives

#### Learning Objective 1

1. Identify and describe pressure switches and the issues associated with testing them.
  - a. Identify and describe pressure switches.
  - b. Describe the issues associated with testing pressure switches.

#### Learning Objective 2

2. Describe the procedures used to inspect, test, and calibrate pressure switches (CT25\_1-17).
  - a. Identify the prerequisites, competencies, and abnormal operating conditions (AOCs) associated with inspecting, testing, and calibrating pressure switches.
  - b. Describe the procedures used to inspect, test, and calibrate pressure switches.

### Performance Task

#### Performance Task 1 (Learning Objective 2)

1. Inspect, test, and calibrate pressure switches (CT25\_1-17).
  - Identify potential abnormal operating conditions (AOCs) 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 certification that test equipment has been calibrated prior to performing calibrations.
  - Verify device set point for switches prior to performing calibration.
  - Determine correct test medium and range to be used for testing.
  - Notify control center and/or affected personnel before work begins.
  - Isolate the pressure switch from the process system and inspect all connection for leakage.
  - Apply test medium pressure and verify device setpoint or range "as found" and document the results.
  - Re-apply test medium for desired setpoint or range and adjust if necessary according to device manufacturer's specifications to establish desired setpoint. Document final setpoint setting(s) "as left".
  - Notify control center and/or affected personnel after completion of work.
  - Complete appropriate documentation as required by operator's procedures.

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### Teaching Time: 7.5 Hours

(Three 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 accompanying PowerPoint® presentations), 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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://www.nccer.org/testing). The passing score for submission into NCCER's Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.

## Safety Considerations

This module requires that trainees work in and around enclosed spaces, with pressurized gases and liquids, and with moderately high temperatures. They may also encounter electrically or pneumatically energized equipment. 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 the pipeline environment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

## Equipment, Materials, and Resources

Whiteboard	Hard hat
Dry-erase markers	Hearing protection
A variety of standard marker sizes	Natural fiber clothing with no metal fasteners
Pencils and paper	Personal monitors (when required)
Poster board	Proper footwear
Flip chart	Safety glasses
<i>Pipeline Electrical &amp; Instrumentation</i>	Work gloves
PowerPoint® Presentations	Pressure switches of various types
LCD projector and screen	Multifunction calibrator
Computer (Internet access optional)	Multimeter
Module Review Questions answer key	Appropriate pressure test medium
Performance Profile sheets	Test leads, tubing, and other hardware to make connections to the pressure switch
Appropriate PPE as directed by the instructor or training facility provider:	Common hand tools
Electrical insulated work gloves	
appropriate for voltages encountered	

# Lesson Plans for Module CT25\_2-17

## Inspect, Test, and Calibrate Pressure Transmitters

Module CT25\_2-17 presents skills and knowledge for inspecting, testing and calibrating pressure transmitters in pipelines. Pressure transmitters are common equipment related to process control, and their correct function is critical to pipeline operation.

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### Objectives

#### Learning Objective 1

1. Identify and describe pressure transmitters and the issues associated with testing them.
  - a. Identify and describe pressure transmitters.
  - b. Describe the issues associated with testing pressure transmitters.

#### Learning Objective 2

2. Describe the procedures used to inspect, test, and calibrate pressure transmitters (CT25\_2-17).
  - a. Identify the prerequisites, competencies, and abnormal operating conditions (AOCs) associated with inspecting, testing, and calibrating pressure transmitters.
  - b. Describe the procedures used to inspect, test, and calibrate pressure transmitters.

### Performance Task

#### Performance Task 1 (Learning Objective 2)

1. Inspect, test, and calibrate pressure transmitters (CT25\_2-17).
  - Identify potential abnormal operating conditions (AOCs) 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 certification that test equipment has been calibrated prior to performing calibrations.
  - Verify range of transmitter prior to performing calibration.
  - Determine correct test medium and the range to be used for testing.
  - Notify control center and/or affected personnel before work begins.
  - Isolate the pressure transmitter from the process system and inspect all connections for leakage.
  - Apply test medium pressure and verify device setpoint or range "as found". Verify pressure transmitters at zero, mid, and full scale calibration points. Document results "as found."
  - Re-apply test medium for zero, mid-scale and full scale. Adjust if necessary according to device manufacturer's specifications to establish desired calibration.
  - Verify activation of digital control output and/or operation of the end device at the established setpoint. Document final setpoint settings "as left."
  - Notify control center and/or affected personnel after completion of work.
  - Complete appropriate documentation as required by operator's procedures.

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### Teaching Time: 7.5 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 accompanying PowerPoint® presentations), 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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://www.nccer.org/testing). The passing score for submission into NCCER's Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.

## Safety Considerations

This module requires that trainees work in and around enclosed spaces, with pressurized gases and liquids, and with moderately high temperatures. They may also encounter electrically or pneumatically energized equipment. 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 the pipeline environment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

## Equipment, Materials, and Resources

Whiteboard	Hearing protection
Dry-erase markers	Natural fiber clothing with no metal fasteners
A variety of standard marker sizes	Personal monitors (when required)
Pencils and paper	Proper footwear
Poster board	Safety glasses
Flip chart	Work gloves
<i>Pipeline Electrical &amp; Instrumentation</i>	Pressure transmitters of various types
PowerPoint® Presentations	Multifunction calibrator
LCD projector and screen	Appropriate pneumatic pressure module and associated connection hardware (if required)
Computer (Internet access optional)	Smart communicator (if required)
Module Review Questions answer key	Appropriate pressure test medium
Performance Profile sheets	Test leads, tubing, and other hardware to make connections to the pressure transmitter
Appropriate PPE as directed by the instructor or training facility provider:	Common hand tools
Electrical insulated work gloves	
appropriate for voltages encountered	
Hard hat	



# Lesson Plans for Module CT26\_0-17

## Verify or Set Protection Parameters for Programmable Controllers and/or Other Instrumentation Control Loops

**Module CT26\_0-17** presents basic methods for tuning and troubleshooting process controllers. It reviews the different types of control loops, their functions, and the methods that are used to tune them. It explains how to verify and set protection parameters and describes how to perform continuity checks and troubleshoot loops, including troubleshooting an oscillating process.

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### Objectives

#### Learning Objective 1

1. Describe control and PID loops and explain how loops are tuned using various methods.
  - a. Describe control loops.
  - b. Describe PID loops.
  - c. Describe the primary methods used to determine loop tuning values and identify factors that affect loop stability.
  - d. Explain how to tune loops using closed-loop methods.
  - e. Explain how to tune loops using open-loop methods.

#### Learning Objective 2

2. Explain how to verify and set protection parameters (CT26\_0-17).
  - a. Identify prerequisites, competencies, and abnormal operating conditions associated with verifying and setting protection parameters.
  - b. Explain the general procedure for verifying and setting protection parameters.

#### Learning Objective 3

3. Explain how to troubleshoot loops.
  - a. Explain how continuity checks are completed.
  - b. Describe various troubleshooting procedures.
  - c. Describe how to troubleshoot an oscillating process.

## Performance Task

### Performance Task 1 (Learning Objective 2)

1. Verify and set protection parameters for programmable controllers and/or other instrumentation control loops (CT26\_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 controlling device.
    - Notify operations control center and/or affected personnel before work begins.
    - Verify that the device setpoint or operating parameters agree with documentation or drawings.
    - Ensure proper isolation of the controlling device from the process system. Verify and document data “as found”.
    - Implement changes to parameters and verify acceptance of parameters.
    - Return controller parameters to desired settings for permanent operation.
    - Verify accuracy and scaling for the analog input device.
    - If a loop controller or PLC is used for overpressure protection, verify activation of digital control output and/or operation of the end device at the established setpoint.
    - If pipeline pressure is maintained using a control valve or speed control, verify operation of analog output and control devices, such as control valve or throttle actuator.
    - Document system parameters “as left.”
    - Notify operations control center and/or affected personnel.
    - 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 accompanying PowerPoint® presentations), 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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://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 and around electrical and pneumatically energized instrumentation equipment that may contain hazardous electrical voltages or current, hazardous fluids, or involve motion. 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  
CT26\_0-17 PowerPoint® Presentation  
DVD player  
Poster board  
Flip chart  
LCD projector and screen  
Computer  
Internet access during class (*optional*)  
Module Review answer key  
Module Examinations  
Specific PPE required by the site  
Process control loop  
Controller reference manuals  
Process control loop diagram or other documentation  
Appropriate programming tools for altering controller settings (*if required*)  
Multifunction calibrator  
Pneumatic test kit (if a pneumatic loop is involved and multifunction calibrator does not include a pressure source)  
Digital or paper chart recorder  
Multimeter  
Calculator  
Test leads, tubing, and other hardware to make connections to the process loop  
Common hand tools  
Copies of Performance Profile sheets

# Lesson Plans for Module CT30\_0-17

## Test Overfill Protective Devices

**Module CT30\_0-17** introduces overfill protection devices (OPDs), their design, and usage. It describes the general procedures for testing OPDs to verify that they are functioning within specifications.

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### Objectives

#### Learning Objective 1

1. Identify and describe the various types of overfill protective devices.
  - a. Identify and describe mechanical OPDs.
  - b. Identify and describe non-contact OPDs.

#### Learning Objective 2

2. Describe the procedures used to test overfill protective devices (CT30\_0-17).
  - a. Identify the prerequisites, competencies, and abnormal operating conditions (AOCs) associated with testing OPDs.
  - b. Describe the procedures used to test OPDs.

### Performance Task

#### Performance Task 1 (Learning Objective 2)

1. Test overfill protective devices (CT30\_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.
    - Notify operations control center prior to performing any test or working on the system.
    - Manually trip the overfill protective device alarm.
    - Verify the operations control center has received the alarms and they have cleared appropriately.
    - Verify that the alarms were received locally and that the alarms cleared appropriately.
    - Verify operation of any devices, such as valves, that might operate as part of a relief flow system.
    - Demonstrate the ability to request equipment repairs or replacement.
    - Notify operations control center and/or affected personnel.
    - 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 accompanying PowerPoint® presentations), 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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://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 in and around enclosed spaces, with pressurized gases and liquids, and with moderately high temperatures. They may also encounter electrically or pneumatically energized 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
- CT30\_0-17 PowerPoint® Presentation
- DVD player
- Poster board
- Flip chart
- LCD projector and screen
- Computer
- Internet access during class (*optional*)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Overfill protective devices of various types
- Multimeter
- Notebook computer and configuration software (if using a non-contact OPD)
- Test leads, tubing, and other hardware to make connections to the OPD
- Common hand tools
- Copies of Performance Profile sheets

# Lesson Plans for Module CT31\_0-17

## Inspect and Calibrate Overfill Protective Devices (Liquid)

**Module CT31\_0-17** introduces overfill protection devices (OPDs), their design, and usage. It describes the general procedures for inspecting and calibrating OPDs to verify that they are functioning within specifications.

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### Objectives

#### Learning Objective 1

1. Identify and describe the various types of overfill protective devices.
  - a. Identify and describe mechanical OPDs.
  - b. Identify and describe non-contact OPDs.

#### Learning Objective 2

2. Describe the procedures used to inspect and calibrate overfill protective devices (CT31\_0-17).
  - a. Identify the prerequisites, competencies, and abnormal operating conditions (AOCs) associated with inspecting and calibrating OPDs.
  - b. Describe the procedures used to inspect and calibrate OPDs.

### Performance Task

#### Performance Task 1 (Learning Objective 2)

1. Inspect and calibrate overfill protective devices (CT31\_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.
  - Notify operations control center prior to performing any test or working on system.
  - Inspect OPD for corrosion or damage. Clean, repair, or replace per the manufacturer's instructions.
  - Test OPD switch.
  - Verify operation of flow control devices and flow switches on relief tanks for operability and/or damage.
  - Demonstrate ability to calibrate OPD switch per manufacturer's instructions.
  - Notify operations control center that inspection, testing and calibration is complete and control is returned to SCADA system.
  - 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 accompanying PowerPoint® presentations), 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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://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 in and around enclosed spaces, with pressurized gases and liquids, and with moderately high temperatures. They may also encounter electrically or pneumatically energized 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
- CT31\_0-17 PowerPoint® Presentation
- DVD player
- Poster board
- Flip chart
- LCD projector and screen
- Computer
- Internet access during class (*optional*)
- Module Review answer key
- Module Examinations
- Specific PPE required by the site
- Overfill protective devices of various types
- Multimeter
- Multifunction calibrator (*as required*)
- Smart communicator (*as required*)
- Notebook computer and configuration software (if using a non-contact OPD)
- Test leads, tubing, and other hardware to make connections to the OPD
- Handline
- Common hand tools
- Copies of Performance Profile sheets

# Inspect, Test, and Maintain Flow Computer for Hazardous Liquid Leak Detection

**Module CT44\_3-17** provides an overview of computational pipeline management systems with particular focus on the role that flow computers play in leak detection. In this module, trainees receive an overview of how flow computers communicate with other components of the CPM system, and how to operate and maintain digital flow computers

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## Objectives

### Learning Objective 1

1. Describe CPM, flow computers, and the technologies used with them.
  - a. Describe computational pipeline management systems.
  - b. Describe flow computers and list their features and capabilities.
  - c. Identify the kinds of digital technologies that flow computers interact with.

### Learning Objective 2

2. Describe the procedures used to inspect, test, and maintain flow computers for hazardous liquid leak detection (CT44\_3-17).
  - a. Identify the prerequisites, competencies, and abnormal operating conditions (AOCs) associated with inspecting, testing, and maintaining flow computers.
  - b. Describe the procedures used to inspect, test, and maintain flow computers for hazardous liquid leak detection.

## Performance Task

### Performance Task 1 (Learning Objective 2)

1. Inspect, test, and maintain a flow computer for hazardous liquid leak detection (CT44\_3-17).
  - Identify potential abnormal operating conditions (AOCs) 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 flow computer's manufacturer and model identifier, preferably from its faceplate.
  - Examine the flow computer and identify everything connected to it.
  - Before beginning any diagnostic or maintenance work, particularly actions that may affect the pipeline operation, obtain permission from the control center.
  - Visually inspect the flow computer for physical damage and proper electrical and I/O connections.
  - If possible, using the flow computer's front panel and controls, check I/O parameters and the status of each connected device.
  - Check each fieldbus, serial data line, and network connection to confirm that it is working correctly.
  - Correct any problems detected, following the appropriate procedure as specified by the manufacturer. After corrective action, re-check the flow computer and its associated devices to confirm that everything is operating correctly.
  - Notify the control center before bringing any equipment back on line.
  - Complete appropriate documentation as required by operator's procedures.

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## Teaching Time: 7.5 Hours

(Three 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 accompanying PowerPoint® presentations), 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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://www.nccer.org/testing). The passing score for submission into NCCER's Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.

## Safety Considerations

This module requires that trainees work with and around pipeline instrumentation and equipment that may contain hazardous electrical voltages or current, hazardous fluids, or involve moving parts. 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 electrical and instrumentation equipment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

## Equipment, Materials, and Resources

Whiteboard	Electrical insulated work gloves
Dry-erase markers	appropriate for voltages encountered
A variety of standard marker sizes	Hard hat
Pencils and paper	Hearing protection
Poster board	Natural fiber clothing with no metal
Flip chart	fasteners
<i>Pipeline Electrical &amp; Instrumentation</i>	Personal monitors (when required)
PowerPoint® Presentation	Proper footwear
LCD projector and screen	Safety glasses
Computer (Internet access optional)	Work gloves
Module Review Questions answer key	Flow computer and associated components
Performance Profile sheets	Reference manuals
Appropriate PPE as directed by the instructor or training facility provider:	Common hand tools

# Lesson Plans for Module CT44\_4-17

## Inspection, Testing, and Corrective and Preventative Maintenance of Tank Gauging for Hazardous Liquid Leak Detection

**Module CT44\_4-17** describes the importance of tank gauging to the petroleum industry in the receipt and transfer of liquid products. The methods and equipment used to accurately track and measure tank levels are discussed. Symptoms of abnormal conditions associated with monitoring and performing maintenance on tank gauging equipment and appropriate pipeline E&I technician responses are reviewed. The general approach to performing tests and maintenance on tank gauging equipment is discussed.

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### Objectives

#### Learning Objective 1

1. Identify and describe custody transfer and the various types of tank gauging devices associated with it as well as how they are serviced.
  - a. Describe custody transfer and its relationship to tank gauging.
  - b. Identify and describe various types of tank gauging devices.
  - c. Describe how tank gauging devices are serviced.

#### Learning Objective 2

2. Describe the procedures used for inspection, testing, and corrective and preventive maintenance of tank gauging for hazardous liquid leak detection (CT44\_4-17).
  - a. Identify the prerequisites, competencies, and abnormal operating conditions (AOCs) associated with inspection, testing, and corrective and preventive maintenance of tank gauging.
  - b. Describe the procedures used for inspection, testing, and corrective and preventive maintenance of tank gauging for hazardous liquid leak detection.

### Performance Task

#### Performance Task 1 (Learning Objective 2)

1. Inspect, test, and perform corrective and preventive maintenance of tank gauging for hazardous liquid leak detection (CT44\_4-17).
  - Identify potential abnormal operating conditions (AOCs) 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 (PPE) according to relevant company procedures.
  - Determine the device's number and nameplate data and confirm the calibration point values for the device.
  - Notify control center and/or affected personnel before work begins.
  - Visually inspect the device and any associated equipment.
  - Confirm that anything that could disturb the tank is shut off, that inlets and outlets are closed, and that the liquid inside the tank is still.
  - Confirm the test equipment's current certification status.
  - Gauge the tank with a certified device (handline, etc.) and compare its result to the tank gauge output.
  - Calibrate the tank gauge following the manufacturer's procedure.
  - Perform all steps required to resume normal operation. Notify control center and/or affected personnel that the unit has been returned to normal operation.
  - Complete appropriate documentation as required by operator's procedures.

## Teaching Time: 7.5 Hours

(Three 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 accompanying PowerPoint® presentations), 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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://www.nccer.org/testing). The passing score for submission into NCCER's Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.

## Safety Considerations

This module requires that trainees work with and around pipeline instrumentation and equipment that may contain hazardous electrical voltages or current, hazardous fluids, or involve moving parts. 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 electrical and instrumentation equipment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

## Equipment, Materials, and Resources

Whiteboard	fasteners
Dry-erase markers	Personal monitors (when required)
A variety of standard marker sizes	Proper footwear
Pencils and paper	Safety glasses
Poster board	Work gloves
Flip chart	Tanks with various gauging devices
<i>Pipeline Electrical &amp; Instrumentation</i>	Gauging sensor reference manuals
PowerPoint® Presentations	Transferring/receiving facility control system diagrams/operations manuals
LCD projector and screen	Handline
Computer (Internet access optional)	Multifunction calibrator
Module Review Questions answer key	Pneumatic test kit (if a pneumatic sensor is involved and multifunction calibrator does not include a pressure source)
Performance Profile sheets	Multimeters
Appropriate PPE as directed by the instructor or training facility provider:	Test leads, tubing, and other hardware to make connections to tank gauging sensors
Electrical insulated work gloves	Common hand tools
appropriate for voltages encountered	
Hard hat	
Hearing protection	
Natural fiber clothing with no metal	

# Lesson Plans for Module CT44\_5-17

## Prove Flow Meters for Hazardous Liquid Leak Detection

**Module CT44\_5-17** describes the various techniques and devices used for calibrating, or proving, pipeline flow meters. The trainee is then instructed on the various competencies required for recognizing and reporting abnormalities associated with flow meter proving, as well as the general approach to conducting flow meter proving in order to aid detection of hazardous fluids leakage.

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### Objectives

#### Learning Objective 1

1. Identify various types of provers and how they are applied and serviced.
  - a. Identify and describe how pipe provers are used.
  - b. Identify and describe how a master meter prover is used.
  - c. Describe how provers are serviced and calibrated.

#### Learning Objective 2

2. Describe the procedures used to prove flow meters for hazardous liquid leak detection (CT44\_5-17).
  - a. Identify the prerequisites, competencies, and abnormal operating conditions (AOCs) associated with proving flow meters.
  - b. Describe the procedures used to prove flow meters for hazardous liquid leak detection.

### Performance Task

#### Performance Task 1 (Learning Objective 2)

1. Prove flow meters for hazardous liquid leak detection (CT44\_5-17).
  - Identify potential abnormal operating conditions (AOCs) 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 (PPE) according to relevant company procedures.
  - Determine the flow meter's number and nameplate data, and confirm the correct flow rate range for the meter in question.
  - Notify control center and/or affected personnel before work begins.
  - Confirm the correct flow rate range for the meter in question by consulting the manufacturer's specifications.
  - If using a portable prover, confirm that the pipeline pressure is within the prover's operating range and make the appropriate connections to the meter.
  - Line up the prover valves to fill and pressurize the prover and purge out all air. Check the equipment integrity to confirm that everything is working as intended.
  - Line up the prover valves for a proving run, check the block and bleed valves for seal integrity, and verify a stable temperature, pressure, and flow rate at the prover and meter.
  - Measure or otherwise ascertain the product's density or API gravity value and stability.
  - Start the proving run.
  - Confirm accurate input data and generate a meter factor through appropriate calculations or by entering the information into the flow computer.
  - Confirm that the new meter factor is appropriate and implement it as required.
  - If using a portable prover, set valves to appropriate positions to release pressure and empty the unit. Disconnect the unit and terminate all connections as necessary.
  - Return all valves to the correct positions for normal operation.
  - Notify the control center, local personnel, and any other affected personnel that the process is complete and normal operations are restored.
  - Complete appropriate documentation as required by operator's procedures.

## Teaching Time: 7.5 Hours

(Three 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 accompanying PowerPoint® presentations), 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 requires that trainees work with and around pipeline instrumentation and equipment that may contain hazardous electrical voltages or current, and pressurized or hazardous fluids. 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 electrical and instrumentation equipment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

## Equipment, Materials, and Resources

Whiteboard	Hard hat
Dry-erase markers	Hearing protection
A variety of standard marker sizes	Natural fiber clothing with no metal fasteners
Pencils and paper	Personal monitors (when required)
Poster board	Proper footwear
Flip chart	Safety glasses
<i>Pipeline Electrical &amp; Instrumentation</i>	Work gloves
PowerPoint® Presentations	Flow meter prover
LCD projector and screen	Flow meters
Computer (Internet access optional)	Flow meter reference manuals
Module Review Questions answer key	Transferring/receiving facility control system diagrams/operations manuals
Performance Profile sheets	Appropriate hardware for making connections to the prover
Appropriate PPE as directed by the instructor or training facility provider:	Common hand tools
Electrical insulated work gloves appropriate for voltages encountered	

# Lesson Plans for Module CT44\_6-17

## Maintain Flow Meters for Hazardous Liquid Leak Detection

**Module CT44\_6-17** introduces trainees to a variety of pipeline flow meter technologies and describes the principles upon which they operate. They learn the key advantages and disadvantages of the instruments and how these influence the need for servicing. The trainee is then instructed in the various competencies required for recognizing and reporting abnormalities associated with flow meter operation and maintenance, as well as the general approach to conducting flow meter maintenance.

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### Objectives

#### Learning Objective 1

1. Describe flow measuring technologies.
  - a. Describe positive displacement flow meters.
  - b. Describe turbine flow meters.
  - c. Describe magnetic flow meters.
  - d. Describe ultrasonic flow meters.
  - e. Describe Coriolis flow meters.
  - f. Describe vortex flow meters.
  - g. Describe orifice flow meters.

#### Learning Objective 2

2. Describe the procedures used to maintain flow meters for hazardous liquid leak detection (CT44\_6-17).
  - a. Identify the prerequisites, competencies, and abnormal operating conditions (AOCs) associated with maintaining flow meters.
  - b. Describe the procedures used to maintain flow meters for hazardous liquid leak detection.

## Performance Task

### Performance Task 1 (Learning Objective 2)

1. Maintain flow meters for hazardous liquid leak detection (CT44\_6-17).
    - Identify potential abnormal operating conditions (AOCs) 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 (PPE) according to relevant company procedures.
    - Determine the flow meter's number and nameplate data in order to verify that it is the correct meter to be maintained.
    - Notify control center and/or affected personnel before work begins.
    - Visually examine the flow meter and assess its physical and mechanical condition. Identify and perform any preventative maintenance as required.
    - Identify any diagnostic steps specified by the manufacturer's documentation and perform them as appropriate.
    - If the meter needs to be disconnected for maintenance, isolate the meter, release pressure, empty the meter and lines, and disconnect the meter.
    - Complete the necessary repairs to the meter.
    - If the meter has been disconnected for the repair, reconnect it correctly.
    - Notify the control center that the meter is being brought online and that commissioning and startup activities have commenced.
    - Bring the meter online by purging it and filling the pipeline.
    - Check the meter and its associated hardware and connections.
    - Notify the control center that the meter is ready for startup and that it should be proved.
    - Complete appropriate documentation as required by operator's procedures.
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### Teaching Time: 7.5 Hours

(Three 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 accompanying PowerPoint® presentations), 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](http://www.nccerirc.com). For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://www.nccer.org/testing). The passing score for submission into NCCER's Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.

### Safety Considerations

This module requires that trainees work with and around pipeline instrumentation and equipment that may contain hazardous electrical voltages or current, and pressurized or hazardous fluids. 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 electrical and instrumentation equipment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

## **Equipment, Materials, and Resources**

Whiteboard

Dry-erase markers

A variety of standard marker sizes

Pencils and paper

Poster board

Flip chart

*Pipeline Electrical & Instrumentation* PowerPoint® Presentations

LCD projector and screen

Computer (Internet access optional)

Module Review Questions answer key

Performance Profile sheets

Appropriate PPE as directed by the instructor or training facility provider:

- Electrical insulated work gloves appropriate for voltages encountered

- Hard hat

- Hearing protection

- Natural fiber clothing with no metal fasteners

- Personal monitors (when required)

- Proper footwear

- Safety glasses

- Work gloves

Flow meters

Flow meter reference manuals

Flow meter test equipment and notebook computers (as required)

Transferring/receiving facility control system diagrams/operations manuals

Test leads, hoses, and other hardware as needed

Common hand tools



# Lesson Plans for Module CT44\_7-17

## Inspect, Test, and Maintain Gravimeters/Densitometers for Hazardous Liquid Leak Detection

**Module CT44\_7-17** identifies and describes the operating principles of the various instruments used to measure pipeline product density. Monitoring product density is essential to custody transfer process and to alert operators of abnormal conditions that may be occurring during a product transfer. Trainees will learn how to service density measuring equipment and recognize abnormal operating conditions relating to petroleum product gravimeters and densitometers.

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### Objectives

#### Learning Objective 1

1. Identify and describe various types of gravimeters and densitometers and how they are serviced.
  - a. Identify and describe various types of gravimeters and densitometers.
  - b. Describe how gravimeters and densitometers are serviced.

#### Learning Objective 2

2. Describe the procedures used to inspect, test, and maintain gravimeters/densitometers for hazardous liquid leak detection (CT44\_7-17).
  - a. Identify the prerequisites, competencies, and abnormal operating conditions (AOCs) associated with inspecting, testing, and maintaining gravimeters/densitometers.
  - b. Describe the procedures used to inspect, test, and maintain gravimeters/densitometers for hazardous liquid leak detection.

## Performance Task

### Performance Task 1 (Learning Objective 2)

1. Inspect, test, and maintain gravimeters/densitometers for hazardous liquid leak detection (CT44\_7-17).
    - Identify potential abnormal operating conditions (AOCs) 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 device's number and nameplate data.
    - Verify certification that test equipment has been calibrated prior to performing calibrations.
    - Notify control center and/or affected personnel before work begins.
    - Visually inspect the device and any associated equipment.
    - Calibrate the device using a pycnometer or hydrometer.
    - Determine the density correction factor using a suitable method and produce an appropriate report.
    - Confirm that the density correction factor is acceptable and enter it into the flow computer.
    - If the unit needs to be removed from the pipeline for repair, determine the current live density value and enter an override to the leak detection system so it can continue operating normally during the maintenance process. Isolate the device, release pressure, empty the device and its piping, and disconnect the unit.
    - Inspect, clean, and repair the device as required.
    - Reconnect the device to the pipeline, taking care that it is correctly oriented for the flow direction (if applicable).
    - Place the device back in-line, purge, and refill the piping with product.
    - Check the instrument loop integrity to confirm that there are no leaks and that the unit is ready to return to service.
    - Notify the control center, local personnel, and any affected personnel that the unit is about to be commissioned and that startup is about to begin.
    - Clear the override density value so a live value will be available for calibration and repeat the calibration procedure.
    - Complete appropriate documentation as required by operator's procedures.
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### Teaching Time: 7.5 Hours

Three 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 accompanying PowerPoint® presentations), 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 requires that trainees work with and around pipeline instrumentation and equipment that may contain hazardous electrical voltages or current, emit nuclear radiation, and hold pressurized or hazardous fluids. 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 electrical and instrumentation equipment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

## **Equipment, Materials, and Resources**

- Whiteboard
- Dry-erase markers
- A variety of standard marker sizes
- Pencils and paper
- Poster board
- Flip chart
- Pipeline Electrical & Instrumentation* PowerPoint® Presentations
- LCD projector and screen
- Computer (Internet access optional)
- Module Review Questions answer key
- Performance Profile sheets
- Appropriate PPE as directed by the instructor or training facility provider:
  - Electrical insulated work gloves appropriate for voltages encountered
  - Hard hat
  - Hearing protection
  - Natural fiber clothing with no metal fasteners
  - Personal monitors (when required)
  - Proper footwear
  - Safety glasses
  - Work gloves
- Gravitometers and densitometers
- Instrument reference manuals
- Test equipment and notebook computers (as required)
- Transferring/receiving facility control system diagrams/operations manuals
- Test leads, hoses, and other hardware as needed
- Common hand tools

# Lesson Plans for Module CT44\_8-17

## Inspect, Test, and Maintain Temperature Transmitters for Hazardous Liquid Leak Detection

**Module CT44\_8-17** describes the important methods of measuring and communicating temperature in a process pipeline. The principal temperature sensors and data transmission methods are discussed. Trainees will learn the general approaches to servicing temperature measuring and transmission equipment as well as recognizing abnormal operating conditions relating to petroleum product temperature monitoring systems.

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### Objectives

#### Learning Objective 1

1. Identify and describe various types of temperature monitoring devices and how they are serviced.
  - a. Identify and describe various types of temperature monitoring devices.
  - b. Describe how temperature monitoring devices are serviced.

#### Learning Objective 2

2. Describe the procedures used to inspect, test, and maintain temperature transmitters for hazardous liquid leak detection (CT44\_8-17).
  - a. Identify the prerequisites, competencies, and abnormal operating conditions (AOCs) associated with inspecting, testing, and maintaining temperature transmitters.
  - b. Describe the procedures used to inspect, test, and maintain temperature transmitters for hazardous liquid leak detection.

## Performance Task

### Performance Task 1 (Learning Objective 2)

1. Inspect, test, and maintain temperature transmitters for hazardous liquid leak detection (CT44\_8-17).
    - Identify potential abnormal operating conditions (AOCs) 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 device's number and nameplate data.
    - Before beginning the calibration process, check that the test equipment has itself been certified, calibrated, and verified, and that the transmitter's input and output ranges are appropriately matched to the end device.
    - Notify the control center, local personnel, and any other personnel who might be affected by the calibration/maintenance procedure.
    - Visually inspect the device and any associated equipment.
    - Obtain an accurate reference temperature measurement from the process by using a certified thermometer.
    - Determine if transmitter calibration is required and document the current results, including all data.
    - Before beginning calibration, use the current live process temperature value to override the sensor data.
    - Disconnect the transmitter's inputs from the sensor and attach the test equipment.
    - Use the test equipment to supply simulated sensor data to the transmitter.
    - Disconnect the test equipment and restore the unit's normal connections. Terminate the override temperature value previously established.
    - Determine if transmitter calibration is required and perform any sensor trim adjustments.
    - Perform all steps required to resume normal operation.
    - Notify the control center, local personnel, and any affected personnel that the unit has been returned to normal operation.
    - Complete appropriate documentation as required by operator's procedures.
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### Teaching Time: 7.5 Hours

(Three 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 accompanying PowerPoint® presentations), 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 requires that trainees work with and around pipeline instrumentation and equipment that may contain hazardous electrical voltages or current and pressurized or hazardous fluids. 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 electrical and instrumentation equipment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

## **Equipment, Materials, and Resources**

Whiteboard

Dry-erase markers

A variety of standard marker sizes

Pencils and paper

Poster board

Flip chart

*Pipeline Electrical & Instrumentation* PowerPoint® Presentations

LCD projector and screen

Computer (Internet access optional)

Module Review Questions answer key

Performance Profile sheets

Appropriate PPE as directed by the instructor or training facility provider:

Electrical insulated work gloves appropriate for voltages encountered

Hard hat

Hearing protection

Natural fiber clothing with no metal fasteners

Personal monitors (when required)

Proper footwear

Safety glasses

Work gloves

Temperature transmitters and sensors

Instrument reference manuals

Multifunction calibrator

Pneumatic testing equipment (as required and if not included in multifunction calibrator)

Smart communicator (as required)

Transferring/receiving facility control system diagrams/operations manuals

Test leads, hoses, and other hardware as needed to connect test equipment to instruments and transmitters

Common hand tools

# Lesson Plans for Module CT55\_0-17

## Maintain Fixed Gas Detection Equipment

**Module CT55\_0-17** presents an introduction to representative categories of analytical equipment associated with a typical pipeline. These instruments monitor and analyze properties of the pipeline contents, as well as detect the presence or absence of specific elements in or around the pipeline equipment. Analytical equipment can also be used by pipeline personnel to test atmospheres and as personal protective devices to indicate when hazardous conditions exist.

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### Objectives

#### Learning Objective 1

1. Explain the purpose of analyzers in the pipeline industry and identify common types of analytical equipment.
  - a. Explain the purpose of analyzers in the pipeline industry.
  - b. Identify the types of analyzers commonly found in a pipeline setting.

#### Learning Objective 2

2. Describe the operation and maintenance of hydrogen sulfide and sulfur analyzers.
  - a. Describe the operation of hydrogen sulfide and sulfur analyzers.
  - b. Describe how to use and maintain hydrogen sulfide and sulfur analyzers.

#### Learning Objective 3

3. Describe the operation and maintenance of chromatographs.
  - a. Describe the operation of chromatographs.
  - b. Describe how to use and maintain chromatographs.

#### Learning Objective 4

4. Describe the operation and maintenance of other types of pipeline analyzers.
  - a. Describe the operation and maintenance of moisture analyzers.
  - b. Describe the operation and maintenance of continuous emissions monitoring systems.
  - c. Describe the operation and maintenance of centrifuges.

#### Learning Objective 5

5. Describe the operation and maintenance of fixed gas detection equipment (CT55\_0-17).
  - a. Describe the operation of fixed gas detection equipment.
  - b. Identify the prerequisites, competencies, and abnormal operating conditions (AOCs) associated with maintaining fixed gas detection equipment.
  - c. Describe the procedures used to maintain fixed gas detection equipment.

## Performance Task

### Performance Task 1 (Learning Objective 5)

1. Maintain fixed gas detection equipment (CT55\_0-17).
    - Identify potential abnormal operating conditions (AOCs) 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.
    - Make appropriate notifications prior to beginning the inspection.
    - Verify proper operations, including the mounting, filters, cable connections, sensor placement, and backup power supply.
    - Check setpoints and alarms.
    - Calibrate gas detector (if needed).
    - Verify sensing elements and replace if necessary.
    - Make appropriate notifications upon completion of the inspection.
    - Complete appropriate documentation as required by operator's procedures.
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### Teaching Time: 25 Hours

(Ten 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 accompanying PowerPoint® presentations), 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 requires that trainees work with and around pipeline instrumentation and equipment that may contain hazardous electrical voltages or current, hazardous fluids, or involve moving parts. 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 electrical and instrumentation equipment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

## **Equipment, Materials, and Resources**

- Whiteboard
- Dry-erase markers
- A variety of standard marker sizes
- Pencils and paper
- Poster board
- Flip chart
- Pipeline Electrical & Instrumentation* PowerPoint® Presentations
- LCD projector and screen
- Computer (Internet access optional)
- Module Review Questions answer key
- Performance Profile sheets
- Appropriate PPE as directed by the instructor or training facility provider:
  - Electrical insulated work gloves appropriate for voltages encountered
  - Hard hat
  - Hearing protection
  - Natural fiber clothing with no metal fasteners
  - Personal monitors (when required)
  - Proper footwear
  - Safety glasses
  - Work gloves
  - Lab-type nitrile gloves
- Access to the following analyzer instruments and equipment:
  - Centrifuge
  - Chromatograph
  - Fixed combustible gas detector
  - Continuous emissions monitoring system
  - Hydrogen sulfide and/or sulfur analyzer
  - Moisture analyzer
  - Fixed vapor detector
- Analyzer/equipment reference manuals
- Appropriate calibration instruments
- Calibration gas cylinders (as required)
- Test leads, tubing, and other hardware to make connections to analyzer instrumentation
- Common hand tools