Module Overview

This module describes plasma arc cutting equipment; safe work area preparation; plasma arc cutting methods for piercing, slotting, squaring, and beveling metals; and proper storage and housekeeping.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Boilermaking Levels One and Two.

Objectives

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

1. Explain the plasma arc cutting processes.
2. Identify plasma arc cutting equipment.
3. Prepare and set up plasma arc cutting equipment.
4. Use plasma arc cutting equipment to make various types of cuts.
5. Properly store equipment and clean the work area after use.

Performance Tasks

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

1. Set up plasma arc cutting equipment.
2. Set the amperage and gas pressures or flow rates for the type and thickness of metal to be cut.
3. Square-cut metal using plasma arc cutting equipment.
5. Pierce and cut slots in metal using plasma arc cutting equipment.
6. Dismantle and store the equipment.

Materials and Equipment

Markers/chalk
Whiteboard/chalkboard
Multimedia projector and screen
Computer
Appropriate personal protective equipment
Leather protective gear (jacket or sleeves)
Various welding gloves
Samples of protective welding footwear
Earplugs
Safety glasses with approved lenses
Full face shields
Welding shield or helmet with appropriate lens
Respirator

Examples of welding job opening postings (welding labs may post them on bulletin boards)
Vendor manuals for PAC equipment showing cutting ratings
Photographs or videos showing large industrial PAC units
Bearings damaged by electric arcs
Soapstone
Tape measure
Pliers
Plasma arc cutting unit with cutting torch and appropriate gas sources
Scrap steel sheet or plate, 12 gauge to ½” thick
Scrap stainless steel sheet or plate, 12 gauge to ½” thick (if available)

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

**Safety Considerations**

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize the special safety precautions associated with welding because of the added potential for fire, burns, respiratory problems, and electrical shock. Ensure that trainees are briefed on shop safety procedures.

**Additional Resources**

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


**Teaching Time for this Module**

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 7½ hours are suggested to cover *Plasma Arc Cutting*. You will need to adjust the time required for testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

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<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<td><strong>Session I. Introduction; Plasma Arc Cutting Processes and Equipment</strong></td>
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<td>A. Introduction</td>
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<td>B. Plasma Arc Cutting Process</td>
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<td>C. Plasma Arc Cutting Equipment</td>
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<td>D. Preparing the Work Area for PAC</td>
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<td>E. Setting Up PAC Equipment</td>
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<tr>
<td>F. PT/Laboratory</td>
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<tr>
<td>Have trainees practice setting up PAC equipment and setting the amperage and gas pressures or flow rates for the type and thickness of metal to be cut. This laboratory corresponds to Performance Tasks 1 and 2.</td>
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</tbody>
</table>
Session II. Operation of Plasma Arc Cutting Equipment

A. Operating PAC Equipment
   1. Square-Cutting Metal
   2. Bevel-Cutting Metal
   3. Piercing and Slot-Cutting Metal

B. PT/Laboratory
   Have trainees practice operating PAC equipment. This laboratory corresponds to Performance Tasks 3 through 5.

Session III. Equipment Storage and Maintenance; Repair; Review and Testing

A. Proper Equipment Storage and Housekeeping

B. PT/Laboratory
   Have trainees practice dismantling and storing the equipment. This laboratory corresponds to Performance Task 6.

C. Repair of Plasma Arc Cutting Equipment

D. Module Review

E. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.

F. Performance Testing
   1. Trainees must complete each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the performance testing requirements.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
Module Overview
This module introduces the trainee to maintenance and safety procedures for boiler pressure components.

Objectives
Upon completion of this module, the trainee will be able to do the following:
1. Identify the pressure components of a boiler and their locations.
2. Explain the procedures required to repair the pressure components of a boiler.

Performance Task
Under the supervision of the instructor, the trainee should be able to do the following:
1. Identify the pressure components of a boiler and their locations.

Materials and Equipment
Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Multimedia projector and screen
Computer
Appropriate personal protective equipment
MSDS for a typical cleaning chemical
If possible, all or any of the following:
Access to a boiler area and a maintenance shop that has boiler parts or equipment in for maintenance or repair
A moisture separator or a section of one
Access to a section of tubing that has been removed for testing, such as a maintenance area
A section of tubing with creep, cracks, or other damage
Module Examinations*
Performance Profile Sheets*

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

Safety Considerations
Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on or around boiler pressure components. Emphasize the importance of proper housekeeping.
Additional Resources

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


Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Boiler Pressure Components*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

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<th>Topic</th>
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<td>4. Riser Tubes</td>
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<td>7. General Maintenance Procedures</td>
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<td>C. Economizers</td>
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<td><strong>Sessions III and IV. Furnaces; Superheaters</strong></td>
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<td>A. Furnaces</td>
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<td>1. Advantages of Water-Cooled Furnaces</td>
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<td>B. Superheaters</td>
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<tr>
<td>1. Advantages of Superheating</td>
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<td>2. Superheater Types</td>
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<td>3. Relationships in Superheater Design</td>
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<td>4. General Maintenance Procedures for Superheaters</td>
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</table>
**Sessions V and VI.  Reheaters; Attemperation**

A. Reheaters
   1. Basic Design
   2. General Maintenance Procedures for Reheaters

B. Attemperation
   1. Attemperators
   2. Universal Pressure (UP) Boiler Attemperator Applications
   3. General Maintenance Procedures

**Sessions VII and VIII.  Internal Headers; Boiler Drains; Heat Recovery Steam Generator (HRSG)**

A. Internal Headers
   1. Boiler Tubing
   2. Headers
   3. Protection of Drums and Headers
   4. Headers and Piping
   5. Maintenance Procedures for Boiler Tubes

B. Boiler Drains
C. Heat Recover Steam Generator (HRSG)
   1. Overview of HRSGs
   2. Maintenance of HRSGs

**Session IX.  Traceability and Accountability**

A. Traceability and Accountability
   1. Materials
   2. Welding
   3. Assembly Traceability and Accountability

B. PT/Laboratory
   - Have trainees identify the pressure components of a boiler and their locations.
   - This laboratory corresponds to Performance Task 1.

**Session X.  Review and Testing**

A. Review

B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

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

This module introduces the trainee to boiler theory of operation, construction, nonpressure components and their general maintenance.

Objectives

Upon completion of this module, the trainee will be able to do the following:
1. Identify the nonpressure components of a boiler and their locations.
2. Explain the procedures required to repair the nonpressure components of a boiler.

Performance Task

Under the supervision of the instructor, the trainee should be able to do the following:
1. Identify the nonpressure components of a boiler and their locations.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Multimedia projector and screen
Computer
Appropriate personal protective equipment
If possible, access to the following:
   Boiler system and furnace area
   Boiler system air heaters and ducting

A collection of new and used or damaged ducting seals and gaskets
Maintenance shop where boiler and burner system parts might be found
Boiler and furnace computer control area
Module Examinations*
Performance Profile Sheets*

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

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working around boilers and on boiler nonpressure components. Emphasize the importance of proper housekeeping.

Additional Resources

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

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover Boiler Nonpressure Components. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

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<td>B. Air Heaters</td>
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<td>1. Recuperative Air Heaters</td>
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<td>3. Air Heater Maintenance</td>
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<td><strong>Sessions II and III. Ductwork Shapes; Ductwork Controls; Fuel Systems</strong></td>
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<td>A. Ductwork Shapes and Sizes</td>
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<td>2. Bellows</td>
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<td>3. Ductwork Maintenance</td>
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<td>1. Dampers</td>
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<td>C. Fuel Systems</td>
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<td>2. Fuel System Maintenance</td>
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<td><strong>Sessions IV and V. Burners</strong></td>
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<td>2. Biomass and Waste Burners</td>
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<td>3. Oil and Gas Burners</td>
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<td>4. Liquor Guns</td>
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<td>5. Igniters</td>
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<td>6. Burner and Igniter Maintenance</td>
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<tr>
<td>B. P/T Laboratory</td>
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</tbody>
</table>

Have trainees identify the nonpressure components of a boiler and their locations. This laboratory corresponds to Performance Task 1.
Session VI. Review and Testing

A. Review

B. Module Examination
1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

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

This module introduces the trainee to the boiler support systems and maintenance required for proper operation.

Objectives

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

1. Identify and describe airflow systems.
2. Explain how solid fuels (coal, biomass, and trash) are used to fire furnaces.
3. Explain how a semi-solid fuel, such as black liquor, is used to fire furnaces.
4. Describe ash removal systems and their maintenance.
5. Explain the equipment used in environmental protection.
6. Identify and describe a feedwater system and blow down tank.

Performance Task

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

1. Identify the process flow of the following:
   - Water system
   - Fuel system
   - Ash removal system
   - Feedwater system
   - Air flow system

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Boilermaking Level Three PowerPoint®
Multimedia projector and screen
Computer
Appropriate personal protective equipment
If possible, access to a facility with the following systems associated with a boiler system:
   Air flow system
   Water system
   Fuel systems
   Black liquor system
   Ash removal system
   Feedwater system

Sufficient unmarked drawings of the following:
   Air flow system
   Water system
   Fuel system
   Black liquor system
   Ash removal system
   Feedwater system
   A fan with adjustable vanes

Module Examinations*
Performance Profile Sheets*

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

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on boiler systems and any associated parts. Emphasize the importance of proper housekeeping.

Additional Resources

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


Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Boiler Auxiliaries*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

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<td>B. Air Flow Equipment</td>
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<td>1. Fan Types</td>
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<td>2. Forced Draft</td>
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<td>3. Induced Draft</td>
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<td>4. Recirculation</td>
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<td>5. Reinjection</td>
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<td>6. Fan Maintenance</td>
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<td>A. Solid Fuels (Coal, Biomass, Trash)</td>
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<td>1. Delivery</td>
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<td>3. Feed Conveyors</td>
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<td>3. Dissolving Tanks and Cyclone Separators</td>
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<td>1. Bottom Ash</td>
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<td>2. Soot Blowers (IR and IK)</td>
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<td>3. Fly Ash (Rotary Feeders)</td>
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Sessions VI–IX. Environmental Protection; Feedwater

A. Environmental Protection
   1. Air Pollution Control
   2. Water Pollution Control
   3. Solid Waste Disposal
   4. Noise Control

B. Feedwater
   1. Corrosion, Deposits, and Control
   2. Demineralization
   3. Condensate Polishing System
   4. Feedwater Heaters

C. PT/Laboratory
   Have the trainees identify the process flows of the following:
   • Water system
   • Fuel system
   • Ash removal system
   • Feedwater system
   • Air flow system
   This laboratory corresponds to Performance Task 1.

Session X. Review and Testing

A. Review

B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

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

This module introduces the trainee to the materials need to minimize and repair boiler hotspots: brick, refractory, insulation, and lagging, referred to as BRIL.

Objectives

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

1. Describe the various types of BRIL.
2. Explain the functions of BRIL.
3. Describe the hazards associated with each type of BRIL.

Performance Tasks

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

Materials and Equipment

- Markers/chalk
- Pencils and scratch paper
- Whiteboard/chalkboard
- Multimedia projector and screen
- Computer
- Appropriate personal protective equipment
- Examples of brick refractory
- Sample pieces of insulation
- Module Examinations*

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

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on boilers and with BRIL. Emphasize the importance of proper housekeeping.

Additional Resources

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

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 5 hours are suggested to cover Brick, Refractory, Insulation, and Lagging (BRIL). You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

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<td>C. Refractory Installation</td>
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<td>5. Hazards of Insulation</td>
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<td>6. Installation Techniques</td>
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<td>E. Lagging</td>
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<td>A. Review</td>
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<td>B. Module Examination</td>
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<tr>
<td>1. Trainees must score 70% or higher to receive recognition from NCCER.</td>
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<tr>
<td>2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.</td>
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Module Overview

This module introduces the trainee to boiler tube problems and how to inspect, test, plug, and replace tubes.

Objectives

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

1. Explain the method for identifying problem tubes.
2. Describe the method for extracting tubes.
3. Describe the method for rolling tubes.
4. Explain the method for plugging tubes.

Performance Tasks

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

1. Measure, roll, and install a rolled tube in a tube sheet.
   - Measure the ID of the tube sheet hole.
   - Measure the OD of the tube.
   - Calculate the required ID of the tube with the proper wall reduction.
   - Install the tube with the proper extension.
   - Swage or stake the tube.
   - Soft-roll the tube.
   - Hard-roll the tube.
   - Measure the ID of the tube.
2. Remove a tube from the tube sheet and wash out the tube using oxyfuel.
3. Properly clean a tube sheet.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Multimedia projector and screen
Computer
Appropriate personal protective equipment
Boat samples and tube samples, both good and bad
OEM tube sheet drawing
Access to the boiler area of a plant
Access to a maintenance area where tubes and tube sheets in various conditions are being worked on
Sufficient tubes and tube sheets in need of cleaning
Oxyacetylene torches and oxyfuel
Tools and attachments for cleaning metals
Different types of tube pullers
One or more induction heaters for tube extraction
Mandrel and hammer
Expanders
Tools for measuring ID and OD of tubes
Sufficient tubes, plugs, and tube sheets for extraction, rolling, and installation
Module Examinations*
Performance Profile Sheets*

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

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working with boilers and boiler tubes. Emphasize the importance of proper housekeeping.

Additional Resources

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


Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover Advanced Tube Work. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td>Sessions I–III. Introduction; Tube Problems; Extraction, Preparation, and Installation</td>
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<tr>
<td>A. Introduction</td>
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<td>B. Identifying Tube Problems</td>
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<td>1. Condition Assessment Examination Methods</td>
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<td>2. Condition Assessment of Boiler Components and Auxiliaries</td>
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<td>3. Damage Mechanisms</td>
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<td>4. Overall Evaluation Program</td>
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<td>5. Detailed Inspection Program</td>
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<tr>
<td>C. Tube Extraction, Tube Sheet Preparation, and Installation</td>
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<tr>
<td>1. Tubing Extraction</td>
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<td>2. Tube Sheet and Tubing End Hole Preparation</td>
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<td>3. Tube Placement (Sticking)</td>
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<td>4. Cleanliness and the Use of Lubricants</td>
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<tr>
<td>D. PT/Laboratory</td>
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<tr>
<td>1. Have trainees remove a tube from the tube sheet and wash out the tube using oxyfuel. This laboratory corresponds to Performance Task 2.</td>
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<tr>
<td>2. Have trainees properly clean a tube sheet. This laboratory corresponds to Performance Task 3.</td>
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</tbody>
</table>
Sessions IV–VII. Tube Rolling; Testing Installed Tubes; Plugging of Tubes

A. Tube Rolling
   1. Guideline Procedures for Rolling Tube Ends into Headers or Drums
   2. Expansion (Rolling) General Procedure

B. Testing Installed Tubes

C. Plugging of Tubes
   1. Pluggable Tubes
   2. Tubes Not to Be Plugged
   3. Guidelines for Plugging Tubes in Drums and Headers

D. P/T Laboratory
   Have trainees measure, roll, and install a rolled tube in a tube sheet.
   • Measure the ID of the tube sheet hole.
   • Measure the OD of the tube.
   • Calculate the required ID of the tube with the proper wall reduction.
   • Install the tube with the proper extension.
   • Swage or stake the tube.
   • Soft-roll the tube.
   • Hard-roll the tube.
   • Measure the ID of the tube.
   This laboratory corresponds to Performance Task 1.

Session VIII. Review and Testing

A. Review

B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

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

This module introduces the trainee to pipe flushing and testing and to the requirements that govern these activities.

Objectives

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

1. List pretest requirements.
2. Describe service and flow tests.
3. Explain head pressure tests.
4. Describe hydrostatic tests.
5. Explain how to perform steam blow tests.

Performance Tasks

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

1. Perform pretest requirements.
2. Perform service and flow tests.
3. Perform head pressure tests.
4. Perform hydrostatic tests.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Multimedia projector and screen
Computer
Appropriate personal protective equipment
Access to areas with piping systems that can be subjected to the following tests:
   Head pressure
   Service and flow
   Hydrostatic

   Access to different tube-testing devices
   Job specification and associated piping drawings
   If possible, examples of the following components:
      Various pigs
      Several types of plugs
      Slip blind
      Steam targets
   Module Examinations*
   Performance Profile Sheets*

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

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on high-pressure piping systems that contain steam or hazardous chemicals. Emphasize the importance of proper housekeeping.
Additional Resources

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


Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Testing Piping Systems and Equipment.* You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

<table>
<thead>
<tr>
<th>Topic</th>
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<tbody>
<tr>
<td>Sessions I and II. Introduction; Pretest Requirements; Service and Flow Tests</td>
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<tr>
<td>A. Introduction</td>
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<td>B. Pretest Requirements</td>
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<td>1. Identifying Test Boundaries</td>
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<td>2. Temporary Attachments</td>
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<td>3. Installing Pressure Gauges</td>
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<td>4. Preparing a System for Testing</td>
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<td>5. Cleaning the System</td>
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<tr>
<td>C. Performing Service and Flow Tests</td>
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<tr>
<td>D. PT/Laboratory</td>
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<tr>
<td>1. Have trainees perform pretest requirements. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>2. Have trainees perform service and flow tests. This laboratory corresponds to Performance Task 2.</td>
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<tr>
<td>Sessions III and IV. Head Pressure Testing</td>
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<tr>
<td>A. Head Pressure Testing</td>
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<tr>
<td>1. Isolating Components to Be Tested</td>
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<tr>
<td>2. Performing a Head Pressure Test</td>
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<tr>
<td>B. PT/Laboratory</td>
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<tr>
<td>Have trainees perform a head pressure test. This laboratory corresponds to Performance Task 3.</td>
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<tr>
<td>Sessions V and VI. Hydrostatic Testing</td>
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<tr>
<td>A. Hydrostatic Testing</td>
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<tr>
<td>1. Performing Pretest Requirements</td>
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<td>2. Preparing Pumps</td>
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<td>3. Sealing System</td>
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<tr>
<td>4. Performing a Hydrostatic Test</td>
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<tr>
<td>B. PT/Laboratory</td>
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<tr>
<td>Have trainees perform hydrostatic tests. This laboratory corresponds to Performance Task 4.</td>
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</tbody>
</table>
Session VII. Pneumatic Testing; Equipment Testing; Steam Blow Test

A. Pneumatic Testing

B. Equipment Testing

C. Steam Blow Test
   1. Steam Targets
   2. Performing a Steam Blow Test

Session VIII. Review and Testing

A. Review

B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

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

This module introduces common and specialty rigging equipment. Trainees will learn how to tie knots, balance loads, and use hand signals to direct crane operators.

Objectives

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

1. Identify and describe the use of common rigging hardware and equipment.
2. Inspect common rigging equipment.
3. Identify special rigging equipment, including:
   - Chain hoists
   - Come-alongs
   - Jacks
   - Tuggers
4. Identify knots used in rigging.
5. Identify the correct hand signals used to guide a crane operator.
6. Identify basic rigging and crane safety procedures.
7. Explain load balancing.

Performance Tasks

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

1. Identify and explain rigging hardware and equipment.
2. Inspect rigging equipment.
3. Select, use, and maintain the following rigging equipment:
   - Chain hoists
   - Come-alongs
   - Jacks
   - Tuggers
4. Explain load balancing.
5. Read and interpret lifting capacity charts.
6. Tie knots used in rigging.
7. Show the following hand signals:
   - Stop
   - Emergency stop
   - Hoist
   - Lower
   - Move slowly

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Multimedia projector and screen
Computer
Appropriate personal protective equipment

Access to an area with operational rigging equipment, including:
- Chain hoists
- Come-alongs
- Jacks
- Tuggers
Examples of both usable and worn wire rope slings, synthetic or round slings, and metal mesh slings

continued
Examples of chain slings
Sufficient natural and synthetic ropes for rope-tying exercises
Sufficient copies of a lifting capacity chart
Module Examinations*
Performance Profile Sheets*

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

**Safety Considerations**

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working around cranes with rigging equipment and heavy loads. Emphasize the importance of proper housekeeping.

**Additional Resources**

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


**Teaching Time for This Module**

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 22½ hours are suggested to cover Rigging. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

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<thead>
<tr>
<th>Topic</th>
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<tbody>
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<td><strong>Sessions I and II. Introduction; Hardware; Slings; Tag Lines</strong></td>
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<tr>
<td>A. Introduction</td>
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<td>B. Rigging Hardware</td>
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<td>1. Hooks</td>
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<td>2. Shackles</td>
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<td>3. Eyebolts</td>
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<td>4. Lifting Lugs</td>
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<td>5. Turnbuckles</td>
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<td>6. Beam Clamps</td>
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<td>7. Plate Clamps</td>
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<td>8. Rigging Plates and Links</td>
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<td>9. Spreader and Equalizer Beams</td>
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<td>C. Slings</td>
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<tr>
<td>1. Sling Capacity</td>
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<td>2. Sling Care and Storage</td>
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<tr>
<td>3. Chain Slings</td>
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</tbody>
</table>
D. PT/Laboratory
   1. Have trainees identify and explain rigging hardware and equipment. This laboratory corresponds to Performance Task 1.
   2. Have trainees inspect rigging equipment. This laboratory corresponds to Performance Task 2.

E. Tag Lines
   1. Selecting Tag Lines
   2. Attaching Tag Lines
   3. Controlling Tag Lines and Load

F. PT/Laboratory
   1. Have trainees tie knots used in rigging. This laboratory corresponds to Performance Task 6.

Sessions III–V. Chain Hoists; Ratchet-Lever Hoists and Come-Alongs; Jacks; Tuggers
A. Chain Hoists
   1. Spur-Geared Chain Hoists
   2. Electric Chain Hoists
   3. Care of Chain Hoists

B. Ratchet-Lever Hoists and Come-Alongs

C. Jacks
   1. Ratchet Jacks
   2. Screw Jacks
   3. Hydraulic Jacks
   4. Inspecting and Using Jacks

D. Tuggers

E. PT/Laboratory
   Have trainees select, use, and maintain the following rigging equipment:
   • Chain hoists
   • Come-alongs
   • Jacks
   • Tuggers
   This laboratory corresponds to Performance Task 3.

Sessions VI and VII. Cranes; Rigging Safety; Power Lines; Hazards and Restrictions; Emergency Response; Lifting Personnel; Lift Planning; Terminology
A. Cranes
   1. Verbal Modes of Communication
   2. Nonverbal Modes of Communication

B. PT/Laboratory
   1. Have trainees show the following hand signals:
      • Stop
      • Emergency stop
      • Hoist
      • Lower
      • Move slowly
   This laboratory corresponds to Performance Task 7.
C. General Rigging Safety
   1. Personal Protection
   2. Equipment and Supervision
   3. Basic Rigging Precautions
   4. Barricades
   5. Load-Handling Safety

D. Working Around Power Lines

E. Site Hazards and Restrictions

F. Emergency Response
   1. Fire
   2. Malfunctions During Lifting Operations
   3. Hazardous Weather

G. Using Cranes to Lift Personnel
   1. Personnel Platform Loading
   2. Personnel Platform Rigging

H. Lift Planning

I. Crane Component Terminology
   1. Load Chart Requirements

J. PT/Laboratory
   1. Have trainees read and interpret lifting capacity charts. This laboratory corresponds to Performance Task 5.

Session VIII. Load Balancing; Rigging Pipe; Rigging Valves; Unloading and Yarding Materials; Hilman Rollers

A. Load Balancing
   1. Center of Gravity

B. PT/Laboratory
   1. Have trainees explain load balancing. This laboratory corresponds to Performance Task 4.

C. Rigging Pipe
   1. Determining the Weight of the Pipe
   2. Blocking
   3. Choking
   4. Lifting
   5. Landing

D. Rigging Valves

E. Guidelines for Unloading and Yarding Materials
   1. Unloading
   2. Using Slings

F. Hilman Rollers
Session IX. Review and Testing

A. Review

B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

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

This module introduces the trainee tower and exchanger components and their functions and the principles of the distillation process.

Objectives

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

1. Explain basic refinery processes, vessel coding, and drums.
2. Identify and explain different types of distillation towers and their functions.
3. Identify and explain different types of distillation tower components and their functions.
4. Describe how heaters, heat exchangers, and coolers operate.
5. Explain catalytic cracking equipment and operations.
6. Explain vessel and exchanger drawings.

Performance Tasks

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

1. Identify the components of a tower.
2. Identify the components of an exchanger.
3. Read and interpret tower and exchanger drawings.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Multimedia projector and screen
Computer
Appropriate personal protective equipment
Sample steam tables
Examples of vessel codes
Unlabeled photographs or drawings of the following:
   Distillation tower components
   Examples of towers and cutaways showing their components
   Common exchanger cutaway drawings showing components
Catalytic cracking equipment cutaway drawings
Drawing of common exchanger
Project drawings of towers and exchangers
As available:
   Access to a distillation tower area
   Access to a maintenance area where tower component work is being done
   Access to an area where exchangers are being worked on
   Examples of: Bubble, sieve, valve, and dual flow trays
   Samples of packing
   Samples of catalytic materials
   Module Examinations*
   Performance Profile Sheets*

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

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on or near distillation towers, heat exchangers, and other components. Emphasize the importance of proper housekeeping.

Additional Resources

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


Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Towers and Exchangers.* You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

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<tr>
<th>Topic</th>
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<td><strong>Sessions I and II. Introduction; Refinery Overview; Vessels; Drums; Towers, Part One</strong></td>
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<tr>
<td>A. Introduction</td>
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<td>B. Overview of the Refinery Process</td>
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<td>1. Properties of Water</td>
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<td>2. Pressure-Temperature Relationships</td>
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<td>3. Steam Cycle Principles of Operation</td>
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<td>4. The Refinery Process</td>
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<td>C. Vessels</td>
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<td>1. Coded</td>
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<td>2. Noncoded</td>
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<td>D. Drums</td>
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<td>E. Towers</td>
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<tr>
<td>1. Main Components of Towers</td>
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<td>F. PT/Laboratory</td>
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<tr>
<td>Have trainees identify the components of a tower. This laboratory corresponds to Performance Task 1.</td>
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<td><strong>Session III. Towers, Part Two</strong></td>
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<td>A. Towers</td>
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<td>1. Types of Towers</td>
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<tr>
<td>2. Feed Types and Tower Styles</td>
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<tr>
<td>3. Maintenance Precautions for Working in Towers</td>
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</tbody>
</table>
Sessions IV and V. Tower Components
A. Tower (Column) Components
   1. Tray Designs
   2. Tray Types
   3. Tray Uses
   4. Tray Attachments
   5. Tray Flow
   6. Safe Removal and Installation of Trays
   7. Packing
   8. Mist Eliminator Pads

Sessions VI and VII. Heaters/Exchangers/Coolers, Part One
A. Heaters/Exchangers/Coolers
   1. Heaters
   2. Heat Exchangers
   3. Coolers and Chillers
B. PT/Laboratory
   Have trainees Identify the components of an exchanger. This laboratory corresponds to Performance Task 2.

Sessions VIII and IX. Heaters/Exchangers/Coolers, Part Two; Crackers; Tower and Exchanger Drawings
A. Heaters/Exchangers/Coolers
   1. Cooling Towers
B. Crackers
   1. Thermal Cracking
   2. Catalytic Cracking
C. Tower and Exchanger Drawings
   1. Bolting Assemblies (Include Fasteners)
   2. Tower Drawings
   3. Tray Drawings
   4. Certified Drawings
D. PT/Laboratory
   Have trainees read and interpret tower and exchanger drawings. This laboratory corresponds to Performance Task 3.

Session X. Review and Testing
A. Review
B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.