

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.
4. Bevel-cut metal using plasma arc equipment.
5. Pierce and cut slots in metal using plasma arc cutting equipment.
6. Dismantle and store the equipment.

Materials and Equipment

Markers/chalk	Examples of welding job opening postings (welding labs may post them on bulletin boards)
Whiteboard/chalkboard	Vendor manuals for PAC equipment showing cutting ratings
<i>Boilermaking Level Three</i> PowerPoint® Presentation	Photographs or videos showing large industrial PAC units
Slides (ISBN 978-0-13-266247-5)	Bearings damaged by electric arcs
Multimedia projector and screen	Soapstone
Computer	Tape measure
Appropriate personal protective equipment	Pliers
Leather protective gear (jacket or sleeves)	Plasma arc cutting unit with cutting torch and appropriate gas sources
Various welding gloves	Scrap steel sheet or plate, 12 gauge to ½" thick
Samples of protective welding footwear	Scrap stainless steel sheet or plate, 12 gauge to ½" thick (if available)
Earplugs	
Safety glasses with approved lenses	
Full face shields	
Welding shield or helmet with appropriate lens	
Respirator	

continued

Scrap aluminum plate, 3/8" to 1/2" thick (if available)
Wire brush
Chipping hammer
Workpiece damaged by improper gas or current settings

Examples of good and bad cuts produced by plasma arc cutting
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. 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.

Recommended Practices for Plasma Arc Cutting, Latest Edition. Miami, FL: The American Welding Society.

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.

Topic	Planned Time
Session I. Introduction; Plasma Arc Cutting Processes and Equipment	
A. Introduction	_____
B. Plasma Arc Cutting Process	_____
C. Plasma Arc Cutting Equipment	_____
D. Preparing the Work Area for PAC	_____
E. Setting Up PAC Equipment	_____
F. PT/Laboratory	_____
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.	

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	Access to a boiler area and a maintenance shop that has boiler parts or equipment in for maintenance or repair
Pencils and scratch paper	A moisture separator or a section of one
Whiteboard/chalkboard	Access to a section of tubing that has been removed for testing, such as a maintenance area
<i>Boilermaking Level Three PowerPoint®</i>	A section of tubing with creep, cracks, or other damage
Presentation Slides (ISBN 978-0-13-266247-5)	Module Examinations*
Multimedia projector and screen	Performance Profile Sheets*
Computer	
Appropriate personal protective equipment	
MSDS for a typical cleaning chemical	
If possible, all or any of the following:	

* 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.

Steam, Its Generation and Use. S.C. Stultz and J.B. Kitto. Barberton, OH: The Babcock and Wilcox Company.

The Control of Boilers. Research Triangle Park, NC: International Society of Automation.

Boiler Operator's Handbook, 2005. Kenneth E. Heselton, PE, CEM. Fairmont Press, Inc: Librun, GA.

The Procedure Handbook of Arc Welding, 2000. Cleveland, OH: The James F. Lincoln Arc Welding Foundation.

Welding Handbook, 2001. Miami, FL: The American Welding Society.

The Dearman System Handbook, 2008. Tulsa, OK: The Mathey Dearman Company.

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.

Topic	Planned Time
Sessions I and II. Introduction; Steam Drum; Economizers	
A. Introduction	_____
B. Steam Drum	_____
1. Steam Drum Characteristics	_____
2. Downcomers	_____
3. Mud Drum	_____
4. Riser Tubes	_____
5. Furnace Walls	_____
6. Moisture Separators	_____
7. General Maintenance Procedures	_____
C. Economizers	_____
1. Types of Economizers	_____
2. General Maintenance Procedures	_____
Sessions III and IV. Furnaces; Superheaters	
A. Furnaces	_____
1. Advantages of Water-Cooled Furnaces	_____
2. Furnace Maintenance	_____
B. Superheaters	_____
1. Advantages of Superheating	_____
2. Superheater Types	_____
3. Relationships in Superheater Design	_____
4. General Maintenance Procedures for Superheaters	_____

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

Boilermaking Level Three PowerPoint[®]

Presentation Slides (ISBN 978-0-13-266247-5)

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.

Steam, Its Generation and Use. S.C. Stultz and J.B. Kitto. Barberton, OH: The Babcock and Wilcox Company.

The Control of Boilers. S.G. Dukelow. Research Triangle Park, NC: International Society of Automation.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *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.

Topic	Planned Time
Session I. Introduction; Air Heaters	
A. Introduction	_____
B. Air Heaters	_____
1. Recuperative Air Heaters	_____
2. Regenerative Air Heaters	_____
3. Air Heater Maintenance	_____
4. Applications	_____
Sessions II and III. Ductwork Shapes; Ductwork Controls; Fuel Systems	
A. Ductwork Shapes and Sizes	_____
1. Seals	_____
2. Bellows	_____
3. Ductwork Maintenance	_____
B. Ductwork Controls	_____
1. Dampers	_____
2. Damper Maintenance	_____
C. Fuel Systems	_____
1. Fluid Fuel Systems	_____
2. Fuel System Maintenance	_____
Sessions IV and V. Burners	
A. Burners	_____
1. Coal Burners	_____
2. Biomass and Waste Burners	_____
3. Oil and Gas Burners	_____
4. Liquor Guns	_____
5. Igniters	_____
6. Burner and Igniter Maintenance	_____
B. P/T Laboratory	_____
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[®]

Presentation Slides (ISBN 978-0-13-266247-5)

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.

Steam, Its Generation and Use. S.C. Stultz and J.B. Kitto. Barberton, OH: The Babcock and Wilcox Company.

The Control of Boilers. S.G. Dukelow. Research Triangle Park, NC: International Society of Automation.

Boiler Operator's Handbook, 2005. Kenneth E. Heselton, PE, CEM. Librun, GA: Fairmont Press, Inc.

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.

Topic	Planned Time
Sessions I and II. Introduction; Air Flow	
A. Introduction	_____
B. Air Flow Equipment	_____
1. Fan Types	_____
2. Forced Draft	_____
3. Induced Draft	_____
4. Recirculation	_____
5. Reinjection	_____
6. Fan Maintenance	_____
Sessions III through V. Solid Fuels; Semi-Solid Fuels; Ash Removal	
A. Solid Fuels (Coal, Biomass, Trash)	_____
1. Delivery	_____
2. Screening Incoming Fuels	_____
3. Feed Conveyors	_____
4. Preparation Equipment	_____
5. Stokers and Grates	_____
B. Processing Semi-Solid Fuels	_____
1. Evaporators	_____
2. Separators	_____
3. Dissolving Tanks and Cyclone Separators	_____
C. Ash Removal	_____
1. Bottom Ash	_____
2. Soot Blowers (IR and IK)	_____
3. Fly Ash (Rotary Feeders)	_____

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

Boilermaking Level Three PowerPoint®

Presentation Slides (ISBN 978-0-13-266247-5)

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.

Steam, Its Generation and Use. S.C. Stultz and J.B. Kitto. Barberton, OH: The Babcock and Wilcox Company.

The Control of Boilers. S.G. Dukelow. Research Triangle Park, NC: International Society of Automation.

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.

Topic	Planned Time
Session I. Introduction; Brick; Refractory; Insulation; Lagging; BRIL Maintenance	
A. Introduction	_____
B. Brick Refractory	_____
1. Types	_____
2. Functions	_____
3. Hazards	_____
C. Refractory Installation	_____
1. Flat Stud Tube Walls	_____
2. Tangent Tube Walls	_____
D. Insulation	_____
1. Types of Insulation	_____
2. Forms of Insulation	_____
3. Finishes	_____
4. Insulation Thickness	_____
5. Hazards of Insulation	_____
6. Installation Techniques	_____
E. Lagging	_____
F. BRIL Maintenance	_____
1. Refractory Maintenance	_____
2. Insulation Maintenance	_____
Session II. 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.	

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	Sufficient tubes and tube sheets in need of cleaning
Pencils and scratch paper	Oxyacetylene torches and oxyfuel
Whiteboard/chalkboard	Tools and attachments for cleaning metals
<i>Boilermaking Level Three PowerPoint®</i>	Different types of tube pullers
Presentation Slides (ISBN 978-0-13-266247-5)	One or more induction heaters for tube extraction
Multimedia projector and screen	Mandrel and hammer
Computer	Expanders
Appropriate personal protective equipment	Tools for measuring ID and OD of tubes
Boat samples and tube samples, both good and bad	Sufficient tubes, plugs, and tube sheets for extraction, rolling, and installation
OEM tube sheet drawing	Module Examinations*
Access to the boiler area of a plant	Performance Profile Sheets*
Access to a maintenance area where tubes and tube sheets in various conditions are being worked on	

* 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.

Steam, Its Generation and Use. S.C. Stultz and J.B. Kitto. Barberton, OH: The Babcock and Wilcox Company.

The Pipe Fitter's Blue Book, W.V. Graves, Webster, TX: The Graves Publishing Company.

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.

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

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

Boilermaking Level Three PowerPoint®

Presentation Slides (ISBN 978-0-13-266247-5)

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.

Steam, Its Generation and Use. S.C. Stultz and J.B. Kitto. Barberton, OH: The Babcock and Wilcox Company.

The Control of Boilers. S.G. Dukelow. Research Triangle Park, NC: International Society of Automation.
CAR-BER Testing website for videos: www.carbertesting.com.

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.

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

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
Boilermaking Level Three PowerPoint®
Presentation Slides (ISBN 978-0-13-266247-5)
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.

Safety and Health Regulations for the Construction Industry, 29 CFR Part 1926. Washington, DC: OSHA Department of Labor, U.S. Government Printing Office.

Basic Rigger, 2011. National Center for Construction Education and Research. Upper Saddle River, NJ: Prentice Hall.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 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.

Topic	Planned Time
Sessions I and II. Introduction; Hardware; Slings; Tag Lines	
A. Introduction	_____
B. Rigging Hardware	_____
1. Hooks	_____
2. Shackles	_____
3. Eyebolts	_____
4. Lifting Lugs	_____
5. Turnbuckles	_____
6. Beam Clamps	_____
7. Plate Clamps	_____
8. Rigging Plates and Links	_____
9. Spreader and Equalizer Beams	_____
C. Slings	_____
1. Sling Capacity	_____
2. Sling Care and Storage	_____
3. Chain Slings	_____

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	Catalytic cracking equipment cutaway drawings
Pencils and scratch paper	Drawing of common exchanger
Whiteboard/chalkboard	Project drawings of towers and exchangers
<i>Boilermaking Level Three PowerPoint®</i>	As available:
Presentation Slides (ISBN 978-0-13-266247-5)	Access to a distillation tower area
Multimedia projector and screen	Access to a maintenance area where tower component work is being done
Computer	Access to an area where exchangers are being worked on
Appropriate personal protective equipment	Examples of : Bubble, sieve, valve, and dual flow trays
Sample steam tables	Samples of packing
Examples of vessel codes	Samples of catalytic materials
Unlabeled photographs or drawings of the following:	Module Examinations*
Distillation tower components	Performance Profile Sheets*
Examples of towers and cutaways showing their components	
Common exchanger cutaway drawings showing components	

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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.

Steam, Its Generation and Use. S.C. Stultz and J.B. Kitto. Barberton, OH: The Babcock and Wilcox Company.

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.

Topic	Planned Time
Sessions I and II. Introduction; Refinery Overview; Vessels; Drums; Towers, Part One	
A. Introduction	_____
B. Overview of the Refinery Process	_____
1. Properties of Water	_____
2. Pressure-Temperature Relationships	_____
3. Steam Cycle Principles of Operation	_____
4. The Refinery Process	_____
C. Vessels	_____
1. Coded	_____
2. Noncoded	_____
D. Drums	_____
E. Towers	_____
1. Main Components of Towers	_____
F. PT/Laboratory	_____
Have trainees identify the components of a tower. This laboratory corresponds to Performance Task 1.	
Session III. Towers, Part Two	
A. Towers	_____
1. Types of Towers	_____
2. Feed Types and Tower Styles	_____
3. Maintenance Precautions for Working in Towers	_____

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.
