

Module Overview

This module describes boiler configurations, boiler applications, and boiler components. It also looks at the different methods used to heat the water and convert it into steam.

Prerequisites

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

Objectives

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

1. Explain the different boiler configurations.
2. Explain the different boiler applications.
3. Identify boiler components.
4. Explain different boiler component functions.

Performance Tasks

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

1. Identify at least four different kinds of boilers as determined by the instructor.
2. Identify at least twelve boiler components as determined by the instructor.

Materials and Equipment

Multimedia projector and screen

Boilermaking Level Two

PowerPoint® Presentation Slides
(ISBN 978-0-13-257333-7)

Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Access to, or pictures of, boiler equipment in
different applications:

Power generation

Hydronic systems

Chemical recovery

Enhanced oil recovery

Marine boilers

Access to, or pictures of, specific boiler
components:

Longflow economizer

Horizontal tube economizer

Steam and mud drums

Downcomers

Copies of company's lockout and tagout proce-
dures

Locks and tags needed for proper lockout

Any required barrier materials

Copies of company's fall protection procedures

Vendor manuals and drawings for different
types of boiler furnaces and their associated
equipment

Access to, or pictures of, boiler equipment:

Coal-fired boiler furnaces

Oil-fired boiler furnaces

Gas-fired boiler furnaces

Fluidized-bed boiler furnaces

Biomass boiler furnaces

Waste-to-energy boiler furnaces

Different types of package boilers

Access to, or pictures of, fuel ignition and
combustion systems used with boilers:

For coal-fired furnaces

For oil-fired furnaces

For gas-fired furnaces

A stoker-grate system

Lower distribution headers

continued

Water wall
 Upper headers or risers
 Superheaters and reheaters
 Attemperators

Nonreturn valves
 Tools of the trade
 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. Review safety guidelines associated with working on or near boiler equipment. 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, 1992. S.C. Stultz. 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 22½ hours are suggested to cover *Boiler Systems and 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; Boiler Configurations	
A. Introduction	_____
B. Boiler Configurations	_____
1. Small Water-Tube Boilers	_____
2. Steam Drum/Subcritical Boilers	_____
3. Once-Through/Supercritical Boilers	_____
4. Fossil Fuel-Fired Boilers	_____
5. Fluidized-Bed Boilers	_____
6. Wood- and Biomass-Fired Boilers	_____
7. Waste-to-Energy Boilers	_____
8. Package Boilers	_____
C. Laboratory	_____
Have trainees identify at least four different kinds or configurations of boilers. This laboratory corresponds to Performance Task 1.	
Sessions III and IV. Boiler Applications	
A. Boiler Applications	_____
1. Power Generation	_____
2. Hydronic and Heating Applications	_____
3. Cogeneration/Combined-Cycle Applications	_____
4. Chemical Recovery Applications	_____
5. Other Specialty Boiler Applications	_____

Module Overview

This module describes the valves most often found in any system requiring the control of liquids or gases and explains how they are installed.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum*; *Boilermaking Level One*; and *Boilermaking Level Two*, Module 34201-11.

Objectives

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

1. Identify types of valves that start and stop flow.
2. Identify types of valves that regulate flow.
3. Identify types of valves that relieve pressure.
4. Identify types of valves that regulate the direction of flow.
5. Identify types of valve actuators.
6. Explain how to properly store and handle valves.
7. Explain valve locations and positions.
8. Explain the factors that influence valve selection.
9. Interpret valve markings and nameplate information.

Performance Tasks

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

1. Identify types of valves that start and stop flow.
2. Identify types of valves that regulate flow.
3. Identify types of valves that relieve pressure.
4. Identify types of valves that regulate the direction of flow.
5. Identify types of valve actuators.
6. Given a selected number of valves, match the valve to its given application.
7. Interpret valve markings and nameplate information.

Materials and Equipment

Multimedia projector and screen

Boilermaking Level Two

PowerPoint® Presentation Slides

(ISBN 978-0-13-257333-7)

Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Access to new and used valves:

Angle valves

Ball valves

Ball check valves

Butterfly valves

Butterfly check valves

Control valves

Diaphragm valves

Flanged end valves

Foot valves

Gate valves

Gate valves with different bonnets and stems

Globe valves

Knife gate valves

Lift check valves

Needle valves

Plug valves

Relief valves

Safety valves

continued

- Swing check valves
- Threaded end valves
- Welded end valves
- Y-type valves
- Copies of company's lockout and tagout procedures
- Locks and tags needed for proper lockout
- Any required barrier materials
- Copies of company's fall protection procedures
- Vendor manuals and drawings for different types of valves and actuators
- Access to new and used actuators:
 - Gear operators
 - Chain operators
 - Pneumatic and hydraulic actuators
 - Electric or air motor-driven actuators

- Access to actual pipelines with installed valves and actuators
- Piping and instrumentation drawings (P&IDs) of actual pipelines and their related components
- Applicable gaskets
- Cut-away examples of valves discussed in this module
- Access to lubricants made for valves
- Access to rigging and lifting hardware capable of lifting and moving large valves
- Vertically mounted sections of pipe with flange connectors to mate with the large valves
- Tools of the boilermaking trade
- 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 valves and boiler equipment. 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.

Choosing the Right Valve. New York, NY: Crane Company.

Piping Pointers; Application and Maintenance of Valves and Piping Equipment. New York, NY: Crane Company.

The Piping Guide, 1980. San Francisco, CA: Syntek Books Company, Ltd.

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 *Identifying and Installing Valves*. 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; Identifying Valves and Actuators	
A. Introduction	_____
B. Valves That Start and Stop Flow	_____
1. Gate Valves	_____
2. Knife Gate Valves	_____
3. Ball Valves	_____
4. Plug Valves	_____
5. Three-Way Valves	_____

C. Laboratory

1. Have trainees match valves with given applications. This laboratory corresponds to Performance Task 6.

D. Laboratory

1. Have trainees interpret valve markings and nameplate information from selected valves. This laboratory corresponds to Performance Task 7.

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 describes the devices used to hang and support the pipe systems of a boiler.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Boilermaking Level One; and Boilermaking Level Two*, Modules 34201-11 and 34202-11.

Objectives

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

1. Identify types of pipe hangers and supports.
2. Identify and interpret pipe support drawings and symbols.
3. Determine field placement of hangers.
4. Identify and install concrete fasteners.
5. Explain how to fabricate angle iron brackets to support pipe.
6. Identify and explain the types of variable spring can supports.
7. Identify and explain the types of constant spring can supports.
8. Explain the storing and handling procedures for spring can supports.
9. Explain how to install spring can supports.
10. Explain how to maintain spring can supports.

Performance Tasks

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

1. Identify types of pipe hangers and supports.
2. Identify types of connecting units and attachments.
3. Identify types of pipe support.
4. Read and interpret support drawings and symbols.
5. Install nonexpanding concrete fasteners.
6. Install expanding concrete fasteners.
7. Lay out and mark the cut lines required to fabricate a one-piece 45-degree angle iron bracket.
8. Lay out and mark the cut lines required to fabricate a one-piece 30- by 60-degree angle iron bracket.
9. Identify spring can support types.
10. Read and interpret spring can support detail sheets.
11. Install spring can supports.
12. Adjust and remove the travel stops from a spring can support.

Materials and Equipment

Multimedia projector and screen

Boilermaking Level Two

PowerPoint® Presentation Slides
(ISBN 978-0-13-257333-7)

Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Access to a variety of pipe hangers:

Adjustable rings and clevises

Double-bolt pipe clamps

Trapeze hangers

Job-fabricated pipe hangers

Access to a variety of hanger connecting units and attachments:

Eyebolts

Turnbuckles

Threaded rods

Rod attachments

Beam clamps

C-clamps

Welded beam attachments

Access to a variety of pipe supports:

U-bolts

Pipe roll supports

Pipe saddles

Extension riser clamps

Wall support clamps

continued

Copies of company's lockout/tagout procedures
 Locks and tags needed for proper lockout
 Any required barrier materials
 Copies of company's fall protection procedures
 Tools of the trade
 Tools to measure, mark, cut, heat, and bend angle iron
 Tools to inspect, clean, measure, and adjust spring can supports
 Access to a variety of concrete fasteners:
 Concrete inserts
 Nonexpanding concrete fasteners
 Wedge-type expanding concrete fasteners
 Expansion case-style of expanding concrete fasteners
 Toggle bolts

Access to a variety of variable and constant spring can supports (Types A, B, C, D, E, F, and G)
 Examples of pipe drawings and detail sheets
 Examples of spring can support detail sheets
 A supply of angle iron for brackets
 Examples of pipe support drawings with related lead sheets
 Access to a variety of snubbers and sway braces
 Access to required rigging equipment
 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 valves and boiler equipment. 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.

- Anvil International provides information on mechanical supports and hangers at www.anvilintl.com.
- Cooper B-Line provides information on pipe supports at www.cooperbline.com.
- NIBCO provides information on hangers at www.nibco.com.
- Piping Technology and Products provides information on spring cans, hangers, and supports at www.pipingtech.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 25 hours are suggested to cover *Pipe Hangers and Supports*. 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; Types of Pipe Hangers and Supports, Part I	
A. Introduction	_____
B. Types of Pipe Hangers and Supports	_____
1. Pipe Hangers	_____
2. Hanger Connecting Units and Attachments	_____
C. Laboratory	_____
1. Have trainees identify types of pipe hangers and supports. This laboratory corresponds to Performance Task 1.	
2. Have trainees identify types of connecting units and attachments. This laboratory corresponds to Performance Task 2.	

**Session II. Types of Hangers and Supports, Part II;
Pipe Support Drawings and Symbols; Field Placement of Hangers**

- A. Pipe Supports
- B. Pipe Support Drawings and Symbols _____
- C. Field Placement of Hangers _____
- D. Laboratory _____
 - 1. Have trainees identify types of pipe support. This laboratory corresponds to Performance Task 3.
 - 2. Have trainees read and interpret pipe support drawings and symbols. This laboratory corresponds to Performance Task 4.

Sessions III and IV. Concrete Fasteners

- A. Concrete Fasteners _____
 - 1. Concrete Inserts _____
 - 2. Nonexpanding Concrete Fasteners _____
 - 3. Adhesive Anchors _____
 - 4. Expanding Concrete Fasteners _____
 - 5. Toggle Bolts _____
- B. Laboratory _____
 - 1. Have trainees install nonexpanding concrete fasteners. This laboratory corresponds to Performance Task 5.
 - 2. Have trainees install expanding concrete fasteners. This laboratory corresponds to Performance Task 6.

Session V. Fabricating Brackets

- A. Fabricating Brackets _____
 - 1. Fabricating 45-Degree Angle Iron Brackets _____
 - 2. Fabricating 30-Degree Angle Iron Brackets _____
- B. Laboratory _____
 - 1. Have trainees lay out and mark the cut lines required to fabricate a one-piece 45-degree angle iron bracket. This laboratory corresponds to Performance Task 7.
 - 2. Have trainees lay out and mark the cut lines required to fabricate a one-piece 30-by 60-degree angle iron bracket. This laboratory corresponds to Performance Task 8.

Session VI. Spring Can Supports

- A. Spring Can Supports _____
 - 1. Variable Spring Can Supports _____
 - 2. Constant Spring Can Supports _____
- B. Storing and Handling of Supports _____
- C. Laboratory _____

Have trainees identify spring can support types. This laboratory corresponds to Performance Task 9.

Sessions VII and VIII. Installing Spring Can Supports

- A. Installing Spring Can Supports
 - 1. Identifying Locations of Supports
 - 2. Installing Supports
 - 3. Removing Travel Stops
 - 4. Adjusting Spring Can Supports

- B. Laboratory
 - 1. Have trainees read and interpret spring can support detail sheets. This laboratory corresponds to Performance Task 10.
 - 2. Have trainees install spring can supports. This laboratory corresponds to Performance Task 11.
 - 3. Have trainees adjust and remove the travel stops from a spring can support. This laboratory corresponds to Performance Task 12.

Session IX. Maintaining Variable Spring Can Supports

- A. Maintaining Variable Spring Can Supports
 - 1. Making Maintenance Checks on Variable Spring Can Supports
 - 2. Replacing Variable Spring Can Supports
 - 3. Special Hangers and Braces for Spring Can Supports

Session X. Review and Testing

- A. Review
- B. Module Examination
 - 1. Trainees must score 70 percent 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 plot plans, structural drawings, elevation drawings, as-built drawings, equipment arrangement drawings, P&IDs, isometric drawings, spool sheets, and detail sheets.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Boilermaking Level One*; and *Boilermaking Level Two*, Modules 34201-11 through 34203-11.

Objectives

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

1. Identify parts of drawings.
2. Identify types of drawings.
3. Make field sketches.
4. Interpret drawing indexes and line lists.

Performance Tasks

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

1. Identify parts of a drawing:
 - Title block
 - Scales and measurements
 - Symbols and abbreviations
 - Notes
 - Revision blocks
 - Coordinates
2. Interpret the following:
 - Drawing indexes
 - Line lists
3. Identify the following types of drawings:
 - Plot plans
 - Structural drawings
 - Elevation and section drawings
 - Equipment arrangement drawings
 - P&IDs
 - Isometric drawings
 - Spool drawings
 - Pipe support drawings and detail sheets
 - Orthographic drawings
4. Make field sketches:
 - Orthographic
 - Isometric

Materials and Equipment

Multimedia projector and screen	Isometric drawings
<i>Boilermaking Level Two</i>	Spool drawings
PowerPoint® Presentation Slides (ISBN 978-0-13-257333-7)	Equipment drawings
Computer	Pipe support drawings
Whiteboard/chalkboard	Orthographic drawings
Markers/chalk	Pencils
Pencils and scratch paper	Sketch pad
Appropriate personal protective equipment	Rulers
Set of blueprints	Several sets of piping drawings
Plot plan	Commercial prints or public works drawings
Structural drawings	Small object such as a pipe fitting or valve for sketching
Elevation and section drawings	Copies of the Quick Quiz*
As-built drawings	Module Examinations**
Equipment arrangement drawings	Performance Profile Sheets**
P&IDs	

* Located at the back of this module.

** 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. This module may require trainees to visit construction sites or utility areas. Ensure that they are briefed on site safety procedures.

Additional Resources

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

Process Piping Drafting, 1986. Rip Weaver. Houston, TX: Gulf 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 15 hours are suggested to cover *Drawings and Detail Sheets*. 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. Identifying and Interpreting Drawings	
A. Introduction	_____
B. Identifying Parts of Drawings	_____
1. Title Blocks	_____
2. Scales and Measurements	_____
3. Symbols and Abbreviations	_____
4. Notes	_____
5. Revision Blocks	_____
6. Coordinates	_____
7. Drawing Indexes	_____
8. Line Lists	_____

C. Laboratory

1. Have trainees practice identifying parts of drawings. This laboratory corresponds to Performance Task 1.
2. Have trainees practice interpreting drawing indexes and line lists. This laboratory corresponds to Performance Task 2.

Session III. Identifying Different Types of Drawings

A. Types of Drawings

1. Plot Plans
2. Structural Drawings
3. Elevation and Section Drawings
4. As-Built Drawings
5. Equipment Arrangement Drawings
6. P&IDs
7. Isometric Drawings
8. Spool Drawings
9. Equipment Drawings
10. Pipe Support Drawings and Detail Sheets
11. Orthographic Drawings

B. Laboratory

Have trainees practice identifying different types of drawings. This laboratory corresponds to Performance Task 3.

Sessions IV and V. Making Field Sketches

A. Field Sketches

1. Orthographic
2. Isometric

B. Laboratory

Have trainees practice making field sketches. This laboratory corresponds to Performance Task 4.

Session VI. Review and Testing

A. Module Review

B. Module Examination

1. Trainees must score 70 percent 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 covers the hardware and systems commonly used by boilermakers. It also describes various types of anchors and supports, their applications, and how to install them safely.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Boilermaking Level One*; and *Boilermaking Level Two*, Modules 34201-11 through 34204-11.

Objectives

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

1. Identify and explain the use of threaded fasteners.
2. Identify and explain the use of non-threaded fasteners.
3. Identify and explain the use of anchors.
4. Select the correct fasteners and anchors for given applications.
5. Install fasteners and anchors.

Performance Tasks

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

1. Install selected threaded fasteners.
2. Install selected screws.
3. Install selected anchors.

Materials and Equipment

Multimedia projector and screen

Boilermaking Level Two

PowerPoint® Presentation Slides
(ISBN 978-0-13-257333-7)

Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Miscellaneous hand tools used with screws,
bolts, and nuts

Various types of screws, bolts, and nuts

Several types of washers

Torque wrench

Retaining rings

Keys

Motor

Pin fasteners

Taper, spring, and cotter pins

Pop rivets

Rivet gun

Tie wraps

Eye bolts

Threaded inserts

U-nuts

J-nuts

Cage nuts

One-step anchors

Wedge anchors

Stud bolt anchors

Sleeve anchors

Hammer-set anchors

Threaded rod anchors

Lead or caulk-in anchors

Single- and double-expansion anchors

Manufacturer's literature on anchors

Masonry anchors

Two-part epoxy anchors

Collection of odd screws, bolts, and fasteners

Thread gauges

Micrometers

Gypsum wallboard (optional)

Plywood (optional)

Weights or other loads

Copies of the Quick Quiz*

Module Examinations**

Performance Profile Sheets**

* Located at the back of this module.

** 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. This module requires trainees to use hand and power tools. Emphasize basic tool safety.

Additional Resources

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

<http://www.confast.com>.

<http://www.boltdepot.com/fastener-information>.

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 *Fasteners and Anchors*. 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; Threaded Fasteners; Non-Threaded Fasteners; Special Threaded Fasteners	
A. Introduction	_____
B. Threaded Fasteners	_____
1. Thread Standards	_____
2. Bolt and Screw Types	_____
3. Nuts	_____
4. Washers	_____
5. Installing Threaded Fasteners	_____
C. Laboratory	_____
1. Have trainees install selected threaded fasteners. This laboratory corresponds to Performance Task 1.	
2. Have trainees install selected screws. This laboratory corresponds to Performance Task 2.	
D. Non-Threaded Fasteners	_____
1. Retainer Fasteners	_____
2. Keys	_____
3. Pin Fasteners	_____
4. Blind/Pop Rivets	_____
5. Tie Wraps	_____
E. Special Threaded Fasteners	_____
1. Eye Bolts	_____
2. Threaded Inserts	_____
3. Panel and Electrical Mounts	_____

Module Overview

This module explains how to identify, interpret, and draw welding symbols found on specifications, drawings, and welding procedure specifications (WPS).

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Boilermaking Level One; and Boilermaking Level Two*, Modules 34201-11 through 34205-11.

Objectives

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

1. Identify and explain the various parts of a welding symbol.
2. Identify and explain fillet and groove weld symbols.
3. Read welding symbols on drawings, specifications, and welding procedure specifications.
4. Interpret welding symbols from a print.

Performance Task

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

1. Identify and interpret welding symbols on a drawing provided by the instructor.

Materials and Equipment

Multimedia projector and screen <i>Boilermaking Level Two</i>	Drawing #AWS EDU-1 (from page 111 of <i>AWS EG 2.0:2006</i>)
PowerPoint® Presentation Slides (ISBN 978-0-13-257333-7)	Sample site quality standard
Computer	Various weld samples as available, including:
Whiteboard/chalkboard	Fillet welds
Markers/chalk	V-groove welds
Pencils and scratch paper	Plug welds
Appropriate personal protective equipment	Slot welds
<i>AWS A2.4:2007 Standard Symbols for Welding, Brazing, and Nondestructive Examination</i>	Samples of various weld joints
	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.

Additional Resources

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

ASTM A325-09a Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength. West Conshohocken, PA: ASTM International, 2009.

AWS A2.4:2007 Standard Symbols for Welding, Brazing, and Nondestructive Examination. Miami, FL: American Welding Society.

AWS A3.0M/A3.0:2010 Standard Welding Terms and Definitions; Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying. Miami, FL: American Welding Society, 2009.

AWS D1.1/D1.1M:2008 (with 2009 errata) Structural Welding Code Steel. Miami, FL: American Welding Society.

How to Read Shop Drawings. Cleveland, OH: The James F. Lincoln Arc Welding Foundation, 2008.

Steel Construction Manual. 13th ed. Chicago, IL: American Institute of Steel Construction, 2008.

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 *Welding Symbols*. 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 trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction to Welding Symbols	
A. Introduction	_____
B. Standard Symbols	_____
C. Welding Symbol Base	_____
1. Weld Symbols	_____
2. Location of Weld Symbols	_____
3. Combining Weld Symbols	_____
4. Sizing and Dimensioning Welds	_____
Session II. Supplemental and Other Weld Symbols; Review and Testing	
A. Supplemental Symbols	_____
1. Weld-All-Around	_____
2. Field Weld	_____
3. Contour Finish	_____
B. Other Weld Symbols	_____
1. Backing and Spacer	_____
2. Back or Backing Weld	_____
3. Melt-Through	_____
4. Surfacing	_____
5. Edge	_____
6. Spot	_____
7. Seam	_____
C. Laboratory	_____
Have trainees practice identifying and interpreting welding symbols on a drawing provided by the instructor. This laboratory corresponds to Performance Task 1.	
D. Review	_____
E. Module Examination	_____
1. Trainees must score 70 percent 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 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 describes the materials used in socket weld piping systems. It explains how to determine pipe lengths between socket weld fittings, how to prepare the pipe and fittings for fit-up, and how to fabricate socket weld fittings.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Boilermaking Level One*; and *Boilermaking Level Two*, Modules 34201-11 through 34206-11.

Objectives

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

1. Identify and explain types of socket weld piping materials.
2. Identify and explain socket weld fittings.
3. Read and interpret socket weld piping drawings.
4. Determine pipe lengths between socket weld fittings.
5. Fabricate socket weld fittings to pipe.

Performance Tasks

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

1. Identify various socket weld fittings.
2. Interpret a socket weld drawing.
3. Calculate pipe lengths from line drawings using the center-to-center method.
4. Calculate pipe lengths from line drawings using the center-to-face method.
5. Calculate pipe lengths from line drawings using the face-to-face method.
6. Align a 90-degree elbow to the end of a pipe.
7. Square a pipe into a 90-degree elbow.
8. Align a flange to the end of a pipe.
9. Align a 45-degree elbow to the end of a pipe.
10. Align pipes joined by a coupling or tee.
11. Install a socket weld valve.

Materials and Equipment

Multimedia projector and screen

Boilermaking Level Two

PowerPoint® Presentation Slides
(ISBN 978-0-13-257333-7)

Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Socket weld fittings

Tape measures

Various types, sizes, and schedules of pipe

Carbon steel pipe

Stainless steel pipe

Various socket weld piping drawings

Specification books

Two-hole flange pins

Calculator

Socket weld flanges

Spring ring inserts or Gap-A-Lets®

Squares

Torpedo levels

Spirit levels

Tripod vises

Jack stands

Ridgid® 300 power drive with pipe cutter

Soapstones

Wraparounds

Socket weld valves

Calipers

continued

Access to qualified welder with all of the tools and materials to perform tack welding
Micrometers
Small objects for shimming

Copies of the Quick Quiz*
Module Examinations**
Performance Profile Sheets**

* Located at the back of this module.

** 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. This module requires trainees to use hand tools to join pipe. Ensure that they 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.

The Pipe Fitters Blue Book. W. V. Graves. Webster, TX: W.V. 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 25 hours are suggested to cover *Socket Weld Pipe Fabrication*. 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. Socket Weld Fittings and Materials	
A. Introduction	_____
B. Socket Weld Pipe Materials	_____
C. Socket Weld Pipe Fittings	_____
D. Socket Weld Flanges	_____
E. Laboratory	_____
Have trainees practice identifying socket weld fittings. This laboratory corresponds to Performance Task 1.	
Session II. Socket Weld Drawings	
A. Double- and Single-Line Drawings	_____
B. Isometric Drawings	_____
C. Piping Symbols	_____
D. Line Numbers and Specifications Book	_____
E. Laboratory	_____
Have trainees practice reading and interpreting socket weld drawings. This laboratory corresponds to Performance Task 2.	

Sessions III and IV. Determining Pipe Lengths Between Fittings

A. Center-to-Center Method _____

B. Laboratory _____

Have trainees practice determining pipe length using the center-to-center method. This laboratory corresponds to Performance Task 3.

C. Center-to-Face Method _____

D. Laboratory _____

Have trainees practice determining pipe length using the center-to-face method. This laboratory corresponds to Performance Task 4.

E. Face-to-Face Method _____

F. Laboratory _____

Have trainees practice determining pipe length using the face-to-face method. This laboratory corresponds to Performance Task 5.

Sessions V and VI. Fabricating Socket Weld Fittings to Pipe, Part I

A. Preparing Pipe and Fittings for Alignment _____

B. Aligning Fittings and Flanges to be Welded _____

1. Aligning 90-Degree Elbow Fitting to Pipe _____

2. Laboratory _____

Have trainees practice aligning a 90-degree elbow fitting to pipe. This laboratory corresponds to Performance Task 6.

3. Squaring Pipe into 90-Degree Elbow Fittings _____

4. Laboratory _____

Have trainees practice squaring pipe into a 90-degree elbow fitting. This laboratory corresponds to Performance Task 7.

Sessions VII and VIII. Fabricating Socket Weld Fittings to Pipe, Part II

A. Aligning Fittings and Flanges to be Welded (Continued) _____

1. Aligning Flange to Pipe _____

2. Aligning 45-Degree Elbow Fitting to Pipe Using Levels _____

3. Aligning 45-Degree Elbow Fitting to Pipe Using Squares _____

3. Aligning Pipe Joined by Couplings _____

B. Laboratory _____

1. Have trainees practice aligning a flange to the end of a pipe. This laboratory corresponds to Performance Task 8.

2. Have trainees practice aligning a 45-degree elbow fitting to a pipe. This laboratory corresponds to Performance Task 9.

3. Have trainees practice aligning pipe joined by couplings or tees. This laboratory corresponds to Performance Task 10.

Session IX. Valves

A. Installing Socket Weld Valves _____

B. Laboratory _____

Have trainees practice installing a socket weld valve. This laboratory corresponds to Performance Task 11.

Session X. Review and Testing

A. Review _____

B. Module Examination _____

1. Trainees must score 70 percent 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 describes the materials used in butt weld piping systems. It explains how to determine pipe lengths between butt weld fittings, prepare the pipe and fittings for fit-up, and fabricate butt weld fittings. It also describes how to select and install backing rings, fabricate channel iron welding jigs, and how to use and care for welding clamps.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Boilermaking Level One*; and *Boilermaking Level Two*, Modules 34201-11 through 34207-11.

Objectives

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

1. Identify butt weld piping materials and fittings.
2. Read and interpret butt weld piping drawings.
3. Prepare pipe ends for fit-up.
4. Determine pipe lengths between fittings.
5. Select and install backing rings.
6. Perform alignment procedures for various types of fittings.

Performance Tasks

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

1. Identify various butt weld fittings.
2. Interpret a butt weld drawing.
3. Clean a beveled pipe end, using a portable grinder.
4. Calculate pipe lengths from line drawings, using the center-to-center method.
5. Calculate pipe lengths from line drawings, using the center-to-face method.
6. Calculate pipe lengths from line drawings, using the face-to-face method.
7. Align straight pipe.
8. Align a pipe to a 45-degree elbow.
9. Align a pipe to a 90-degree elbow.
10. Square a pipe into a 90-degree elbow.
11. Align a pipe to a flange.
12. Align a pipe to a tee.
13. Install a butt weld valve.

Materials and Equipment

Multimedia projector and screen
Boilermaking Level Two
PowerPoint® Presentation Slides
(ISBN 978-0-13-257333-7)

Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Various sizes of carbon steel pipe
Butt weld fittings

Butt weld flanges
Piping drawings
Portable grinders
Pipe beveller (optional)
Oxyacetylene pipe-beveling machine (optional)
Pipefitting guidebooks
Specification book
Fitting manufacturer's literature on takeout
Calculators
Carbon steel pipe
Stainless steel pipe

continued

Various backing rings
 Scrap angle iron
 Scrap channel iron
 Steel plate
 Hacksaws
 Torch
 Acetylene cylinder
 Oxygen cylinder
 Bottle cart
 Hose sets
 Regulators
 Strikers
 Cutting goggles
 Full-face shields
 Tape measures
 Soapstones
 Lever-type clamps
 Hydraulic clamps
 Chain-type clamps

Aligning dogs
 Hi-Lo gauge
 Center finder
 Straight pipe welding clamps
 Framing squares
 Hammers
 Jack stands
 Wraparounds
 Wrenches
 Pipe vises
 Spirit levels
 Torpedo levels
 Tripod vises
 Two-hole flange pins
 Flange welding clamps
 Copies of the Quick Quiz*
 Module Examinations**
 Performance Profile Sheets**

* Located in the back of this module.

** 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. This module requires trainees to use grinders and other power tools. Ensure all trainees are briefed on power tool safety and shop safety procedures. This module requires trainees to use an oxyacetylene torch. Ensure all trainees are briefed on safety equipment and fire safety.

Additional Resources

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

The Pipe Fitters Blue Book. W. V. Graves. Webster, TX: W.V. 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 40 hours are suggested to cover *Butt Weld Pipe Fabrication*. 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; Butt Weld Piping Materials; Butt Weld Fittings	
A. Introduction	_____
B. Butt Weld Piping Materials	_____
C. Butt Weld Fittings	_____
D. Laboratory	_____
Have trainees practice identifying butt weld fittings. This laboratory corresponds to Performance Task 1.	

Session II. Butt Weld Piping Drawings

- A. Double- and Single-Line Drawings
- B. Isometric Drawings
- C. Piping Symbols
- D. Line Numbers and Specifications Book
- E. Laboratory

Have trainees practice reading and interpreting butt weld drawings.
This laboratory corresponds to Performance Task 2.

Sessions III and IV. Preparing Pipe Ends for Fit-Up

- A. Beveling Using Grinders
- B. Beveling Using Pipe Bevelers
- C. Laboratory

Have trainees practice beveling pipe using a pipe beveler.

- D. Thermal Beveling
- E. Cleaning Surfaces
- F. Laboratory

Have trainees practice cleaning a beveled pipe end using a grinder.
This laboratory corresponds to Performance Task 3.

Sessions V and VI. Determining Pipe Lengths Between Fittings

- A. Calculating Takeout
- B. Obtaining Proper Spacing
- C. Center-to-Center Method
- D. Laboratory

Have trainees practice determining pipe length using the center-to-center method.
This laboratory corresponds to Performance Task 4.

- E. Center-to-Face Method
- F. Laboratory

Have trainees practice determining pipe length using the center-to-face method.
This laboratory corresponds to Performance Task 5.

- G. Face-to-Face Method
- H. Laboratory

Have trainees practice determining pipe length using the face-to-face method.
This laboratory corresponds to Performance Task 6.

Sessions VII and VIII. Selecting and Installing Backing Rings; Using and Caring for Alignment Tools; Alignment Procedures, Part I

- A. Selecting and Installing Backing Rings
- B. Laboratory
- C. Using and Caring for Alignment Tools
- D. Alignment Procedures, Part I

- 1. Aligning Straight Pipe
- 2. Laboratory

Have trainees practice aligning straight pipe. This laboratory corresponds to Performance Task 7.

Sessions IX and X. Alignment Procedures, Part II

A. Aligning Pipe to a 45-Degree Elbow _____

B. Laboratory _____

Have trainees practice aligning pipe to a 45-degree elbow. This laboratory corresponds to Performance Task 8.

C. Aligning Pipe to a 90-Degree Elbow _____

D. Laboratory _____

Have trainees practice aligning pipe to a 90-degree elbow. This laboratory corresponds to Performance Task 9.

E. Squaring Pipe to a 90-Degree Elbow _____

F. Laboratory _____

Have trainees practice squaring pipe to a 90-degree elbow. This laboratory corresponds to Performance Task 10.

Sessions XI and XII. Alignment Procedures, Part III

A. Aligning Pipe to Flange _____

B. Laboratory _____

Have trainees practice aligning a pipe to a flange. This laboratory corresponds to Performance Task 11.

C. Aligning Pipe to A Tee _____

D. Laboratory _____

Have trainees practice aligning a pipe to a tee. This laboratory corresponds to Performance Task 12.

Sessions XIII–XV. Valves

A. Fitting Butt Weld Valves _____

B. Laboratory _____

Have trainees practice installing a valve. This laboratory corresponds to Performance Task 13.

Session XVI. Review and Testing

A. Review _____

B. Module Examination _____

1. Trainees must score 70 percent 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

The tubes inside a boiler system operate under extreme levels of heat and pressure. Part of a boilermaker's job is to repair or remove and replace boiler tubes. This module describes the methods and devices used to prepare and install boiler tubes.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Boilermaking Level One*; and *Boilermaking Level Two*, Modules 34201-11 through 34208-11.

Objectives

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

1. Describe the proper methods used to prepare a single boiler tube or a section of boiler tubes for replacement.
2. Describe the various methods used to obtain access to a boiler tube requiring repair.
3. Fit-up a section of boiler tube for replacement.
4. Describe the welding procedures when performing butt welds on standard carbon steel tubes and composite tubes.

Performance Tasks

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

1. Identify the proper techniques for gaining tube access.
2. Remove a tube and prepare a panel for tube replacement.
3. Cut, prepare, and fit tube into panel for welding.

Materials and Equipment

Multimedia projector and screen

Boilermaking Level Two

PowerPoint® Presentation Slides
(ISBN 978-0-13-257333-7)

Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Pictures of boiler tube failures

Pictures of superheater tubes

As available, samples of the following boiler tubes:

Boiler tubes that have failed

Removed boiler tubes properly encapsulated

Composite tubes used in newer boilers

Boiler tubes with different wall thicknesses

Boiler tubes with and without weld overlay

Tools of the boilermaking trade

Access to tools used to:

Clean, cut, heat, bend, and bevel boiler tubes

Measure and mark boiler tubes

Copies of company's lockout and tagout procedures

Locks and tags needed for proper lockout

Any required barrier materials

Copies of company's fall protection procedures

Copies of company's confined space permits

Copies of company's hot work permits

Access to a boiler or header (or simulator) to which tubes can be attached

Access to boiler tube panels where access windows can be removed and replaced

A supply of purge dam material

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 valves and boiler equipment. 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.

The Pipe Fitters Blue Book. W. V. Graves. Webster, TX: W.V. Graves Publishing Company.
Boiler Operator's Handbook, 2005. Ken Heselton. Lilburn, GA: Fairmont Press.

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 *Tube Weld Preparation and Fitting*. 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; Tube Replacement Issues	
A. Introduction	_____
B. Tube Replacement Issues	_____
1. Collecting Tube Samples for Analysis	_____
2. Tube Access for Welding	_____
C. Laboratory	_____
1. Have trainees identify the proper techniques for gaining tube access. This laboratory corresponds to Performance Task 1.	
2. Have trainees remove a tube and prepare a panel for tube replacement. This laboratory corresponds to Performance Task 2.	
Sessions III and IV. Tube Section Replacement Guidelines	
A. Tube Section Replacement Guidelines	_____
1. Preparing Tubes for Welding	_____
2. Fit-Up, Positioning, and Welding	_____
3. Welding Tubes of Different Wall Thicknesses	_____
4. Repair of Tubes Rolled into a Header or Drum	_____
5. Window Welds	_____
6. Replacing a Tube in a Welded Tangent Furnace Wall	_____
7. Replacing a Tube in Older Water Wall Furnaces	_____
8. Replacing a Tube in a Membrane-Style Furnace Wall	_____
9. Extensive Tube Replacement	_____
10. Tube Attachments	_____
C. Laboratory	
Have trainees cut, prepare, and fit tube into panel for welding. This laboratory corresponds to Performance Task 3.	

**Session V. Tube Welding; Special Tube Installations;
Replacing a Tube in a Superheated Area**

- A. Tube Welding
 - 1. Butt Welds
 - 2. Composite Tube Butt Welds
 - 3. Weld Overlay
 - 4. Preheat and Postheat Guidelines
- B. Special Tube Installations
 - 1. Gaining Access
 - 2. Removing Defective Tubes
 - 3. Preparing Replacement Tubes
 - 4. Installing Replacement Tubes
 - 5. Closing Access Windows
- C. Replacing a Tube in a Superheated Area

Session VI. Review and Testing

- A. Review
- B. Module Examination
 - 1. Trainees must score 70 percent 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 describes air carbon arc cutting (CAC-A) equipment, safe work area preparation, CAC-A methods for cutting and cleaning defective metals, CAC-A methods for gouging and preparing base metals, and proper storage and housekeeping of CAC-A equipment.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Boilermaking Level One*; and *Boilermaking Level Two*, Modules 34201-11 through 34209-11.

Objectives

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

1. Identify and explain the air carbon arc cutting (CAC-A) process and equipment.
2. Select and install CAC-A electrodes.
3. Prepare the work area and CAC-A equipment for safe operation.
4. Use CAC-A equipment for washing and gouging activities.

Performance Tasks

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

1. Select and install CAC-A electrodes.
2. Prepare the work area and CAC-A equipment for safe operation.
3. Use CAC-A equipment for washing.
4. Use CAC-A equipment for gouging.
5. Perform storage and housekeeping activities for CAC-A equipment.

Materials and Equipment

Multimedia projector and screen
Boilermaking Level Two
PowerPoint® Presentation Slides
(ISBN 978-0-13-257333-7)
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Leather protective gear (jacket or sleeves)
Various welding gloves
Samples of protective welding footwear
Welding shield or helmet with appropriate lenses
Earplugs
Safety glasses with approved lenses
Full face shields
Respirator
Soapstone
Tape measure

Pliers
Wire brush
Chipping hammer
CAC-A unit with cutting torch and appropriate gas sources
Scrap steel shapes containing bolts, rivets, protruding welds, eyes, clips, and other protrusions to be washed
DC welding machine, minimum 200 amps for light duty, or 600 amps for medium duty
Air carbon arc torch and cable
Selection of carbon electrodes up to 3/8"
Compressed air source, minimum of 16 cfm at 80 psig for light and medium duty, or minimum of 50 cfm at 100 psig for heavy duty
Copies of the Performance Task Activities sheet (optional)*
Module Examinations**
Performance Profile Sheets**

* Located at the back of this module.

** 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.

ANSI Z49.1:2005, Safety in Welding, Cutting, and Allied Processes, Latest edition. Miami, FL: American Welding Society.

AWS C5.3, Recommended Practices for Air Carbon Arc Gouging and Cutting, Latest edition. Miami, FL: 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 12½ hours are suggested to cover *Air Carbon Arc Cutting and Gouging*. 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; Air Carbon Arc Cutting (CAC-A) Process and Equipment	
A. Introduction	_____
B. CAC-A Process	_____
C. CAC-A Equipment	_____
Session II. Selection and Installation of CAC-A Electrodes	
A. CAC-A Electrodes	_____
B. Electrode Selection	_____
C. Electrode Installation	_____
D. Laboratory	_____
Have trainees practice selecting and installing electrodes. This laboratory corresponds to Performance Task 1.	
Session III. Preparing Work Area and CAC-A Equipment	
A. Preparing Work Area for CAC-A	_____
B. Setting Up CAC-A Equipment	_____
C. Test Operating CAC-A Equipment	_____
D. Laboratory	_____
Have trainees practice setting up the work area and the CAC-A equipment. This laboratory corresponds to Performance Task 2.	

Session IV. Washing and Gouging with CAC-A Equipment

A. CAC-A Planning _____

B. CAC-A Washing _____

C. Laboratory _____

Have trainees practice CAC-A washing. This laboratory corresponds to Performance Task 3.

D. CAC-A Gouging _____

E. Laboratory _____

Have trainees practice CAC-A gouging. This laboratory corresponds to Performance Task 4.

F. Beveling with CAC-A _____

Session V. Proper CAC-A Equipment Storage and Repair; Review and Testing

A. Proper Storage of CAC-A Equipment _____

B. Repair of CAC-A Equipment _____

C. Laboratory _____

Have trainees practice storage and housekeeping activities on CAC-A equipment. This laboratory corresponds to Performance Task 5.

D. Module Review _____

E. Module Examination _____

1. Trainees must score 70 percent 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.

G. Performance Task Activities (as applicable) _____

1. Have trainees perform the task activity sheet, CAC-A Washing and Gouging. This task corresponds to AWS EG2.0, Module 8 – Thermal Cutting Processes, Unit 4 – Manual Air Carbon Arc Cutting (CAC-A), Key Indicators: 4 & 5.