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


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 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 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
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.


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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td>Sessions I and II. Introduction; Boiler Configurations</td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Boiler Configurations</td>
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<tr>
<td>1. Small Water-Tube Boilers</td>
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<td>2. Steam Drum/Subcritical Boilers</td>
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<td>3. Once-Through/Supercritical Boilers</td>
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<td>4. Fossil Fuel-Fired Boilers</td>
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<td>5. Fluidized-Bed Boilers</td>
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<td>6. Wood- and Biomass-Fired Boilers</td>
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<td>7. Waste-to-Energy Boilers</td>
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<td>8. Package Boilers</td>
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<td>C. Laboratory</td>
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<tr>
<td>Have trainees identify at least four different kinds or configurations of boilers. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>Sessions III and IV. Boiler Applications</td>
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<tr>
<td>A. Boiler Applications</td>
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<td>1. Power Generation</td>
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<td>2. Hydronic and Heating Applications</td>
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<td>3. Cogeneration/Combined-Cycle Applications</td>
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<td>4. Chemical Recovery Applications</td>
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<td>5. Other Specialty Boiler Applications</td>
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</table>
Sessions V and VI. Boiler Components

A. Boiler Components
   1. Economizers
   2. Steam Drums
   3. Downcomers
   4. Lower or Mud Drums
   5. Lower Distribution Headers
   6. Water Walls
   7. Boiler Banks and Generator Banks
   8. Upper Headers/Risers
   9. Superheaters and Reheaters
   10. Attemperators
   11. Nonreturn Valves

B. Laboratory
   Have trainees identify at least twelve boiler components. This laboratory corresponds to Performance Task 2.

Sessions VII and VIII. Fuel Combustion Systems

A. Fuel Combustion Systems
   1. Coal-Fired Burners
   2. Oil- and Gas-Fired Burners
   3. Wood and Biomass Burners
   4. Chemical Recovery Burners
   5. Cyclone Furnace
   6. Fluidized Bed Combustion

Session IX. 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 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
- 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
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.


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.

<table>
<thead>
<tr>
<th>Topic</th>
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<tbody>
<tr>
<td>Sessions I and II. Introduction; Identifying Valves and Actuators</td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Valves That Start and Stop Flow</td>
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<tr>
<td>1. Gate Valves</td>
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<td>2. Knife Gate Valves</td>
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<td>3. Ball Valves</td>
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<td>4. Plug Valves</td>
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<td>5. Three-Way Valves</td>
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</tbody>
</table>

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*
C. Valves That Regulate Flow
   1. Globe Valves
   2. Y-Type Valves
   3. Butterfly Valves
   4. Diaphragm Valves
   5. Needle Valves
D. Control Valves
E. Valves That Relieve Pressure
   1. Safety Valves
   2. Pressure-Relief Valves
F. Valves That Regulate Direction of Flow
   1. Swing Check Valves
   2. Lift Check Valves
   3. Ball Check Valve
   4. Butterfly Check Valves
   5. Foot Valves
G. Valve Actuators
   1. Gear Operators
   2. Chain Operators
   3. Pneumatic and Hydraulic Actuators
   4. Electric or Air Motor-Driven Actuators

Sessions III and IV. Laboratory
   A. Laboratory
      Have trainees identify valves that start and stop flow, regulate flow, relieve pressure, and regulate the direction of flow. This laboratory corresponds to Performance Tasks 1–4.
   B. Laboratory
      Have the trainees identify the valve actuators used with those valves. This laboratory corresponds to Performance Task 5.

Sessions V and VI. Storing and Handling Valves; Installing Valves
   A. Storing and Handling Valves
      1. Safety Considerations
      2. Storing Valves
      3. Rigging and Moving Valves
   B. Installing Valves

Session VII. Valve Selection; Valve Markings and Nameplate Information
   A. Valve Selection
   B. Valve Markings and Nameplate Information
      1. Rating Designation
      2. Trim Identification
      3. Size Designation
      4. Thread Markings
      5. Valve Schematic Symbols
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
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
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.

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<tr>
<th>Topic</th>
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<tr>
<td>Session I. Introduction; Types of Pipe Hangers and Supports, Part I</td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Types of Pipe Hangers and Supports</td>
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<tr>
<td>1. Pipe Hangers</td>
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<tr>
<td>2. Hanger Connecting Units and Attachments</td>
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<tr>
<td>C. Laboratory</td>
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<tr>
<td>1. Have trainees identify types of pipe hangers and supports. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>2. Have trainees identify types of connecting units and attachments. This laboratory corresponds to Performance Task 2.</td>
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</tbody>
</table>
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  
* Boilermaking Level Two
  * PowerPoint® Presentation Slides
  * Computer
  * Whiteboard/chalkboard
  * Markers/chalk
  * Pencils and scratch paper
  * Appropriate personal protective equipment
  * Set of blueprints
  * Plot plan
  * Structural drawings
  * Elevation and section drawings
  * As-built drawings
  * Equipment arrangement drawings

P&IDs

Isometric drawings
Spool drawings
Equipment drawings
Pipe support drawings
Orthographic drawings
Pencils
Sketch pad
Rulers

Several sets of piping drawings
Commercial prints or public works drawings
Small object such as a pipe fitting or valve for sketching
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 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.


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.

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<td>B. Identifying Parts of Drawings</td>
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<tr>
<td>1. Title Blocks</td>
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<td>2. Scales and Measurements</td>
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<td>3. Symbols and Abbreviations</td>
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<td>4. Notes</td>
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<td>5. Revision Blocks</td>
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<td>6. Coordinates</td>
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<td>7. Drawing Indexes</td>
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<td>8. Line Lists</td>
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* Multimedia projector and screen
* Boilermaking Level Two
  * PowerPoint® Presentation Slides
  * Computer
  * Whiteboard/chalkboard
  * Markers/chalk
  * Pencils and scratch paper
  * Appropriate personal protective equipment
  * Set of blueprints
  * Plot plan
  * Structural drawings
  * Elevation and section drawings
  * As-built drawings
  * Equipment arrangement drawings
  
P&IDs
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
- 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.


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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td>Session I. Introduction; Threaded Fasteners; Non-Threaded Fasteners; Special Threaded Fasteners</td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Threaded Fasteners</td>
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<tr>
<td>1. Thread Standards</td>
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<td>2. Bolt and Screw Types</td>
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<td>3. Nuts</td>
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<td>4. Washers</td>
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<tr>
<td>5. Installing Threaded Fasteners</td>
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<tr>
<td>C. Laboratory</td>
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</tr>
<tr>
<td>1. Have trainees install selected threaded fasteners. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>2. Have trainees install selected screws. This laboratory corresponds to Performance Task 2.</td>
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<tr>
<td>D. Non-Threaded Fasteners</td>
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<tr>
<td>1. Retainer Fasteners</td>
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<td>2. Keys</td>
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<td>3. Pin Fasteners</td>
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<td>4. Blind/Pop Rivets</td>
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<td>5. Tie Wraps</td>
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<tr>
<td>E. Special Threaded Fasteners</td>
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<tr>
<td>1. Eye Bolts</td>
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<td>2. Threaded Inserts</td>
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<tr>
<td>3. Panel and Electrical Mounts</td>
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</tbody>
</table>
Session II. Mechanical Anchors; Epoxy Anchoring Systems; Review and Testing

A. Mechanical Anchors
   1. One-Step Anchors
   2. Bolt Anchors
   3. Screw Anchors
   4. Self-Drilling Anchors
   5. Guidelines for Drilling Anchor Holes in Hardened Concrete or Masonry

B. Epoxy Anchoring Systems

C. Laboratory
   Have trainees install selected anchors. This laboratory corresponds to Performance Task 3.

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 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 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
Boilermaking Level Two
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
AWS A2.4:2007 Standard Symbols for Welding, Brazing, and Nondestructive Examination

Drawing #AWS EDU-1 (from page 111 of AWS EG 2.0:2006)
Sample site quality standard
Various weld samples as available, including:
Fillet welds
V-groove welds
Plug welds
Slot welds
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.


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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tr>
<td>Session I. Introduction to Welding Symbols</td>
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<tr>
<td>A. Introduction</td>
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<td>B. Standard Symbols</td>
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<td>C. Welding Symbol Base</td>
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<tr>
<td>1. Weld Symbols</td>
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<td>2. Location of Weld Symbols</td>
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<td>3. Combining Weld Symbols</td>
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<td>4. Sizing and Dimensioning Welds</td>
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<tr>
<td>Session II. Supplemental and Other Weld Symbols; Review and Testing</td>
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<tr>
<td>A. Supplemental Symbols</td>
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<td>1. Weld-All-Around</td>
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<td>2. Field Weld</td>
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<td>3. Contour Finish</td>
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<td>B. Other Weld Symbols</td>
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<tr>
<td>1. Backing and Spacer</td>
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<td>2. Back or Backing Weld</td>
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<td>3. Melt-Through</td>
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<td>4. Surfacing</td>
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<td>5. Edge</td>
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<td>6. Spot</td>
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<td>7. Seam</td>
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<tr>
<td>C. Laboratory</td>
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<tr>
<td>Have trainees practice identifying and interpreting welding symbols on a drawing provided by the instructor. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>D. Review</td>
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<tr>
<td>E. Module Examination</td>
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</tr>
<tr>
<td>1. Trainees must score 70 percent or higher to receive recognition from NCCER.</td>
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<tr>
<td>2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.</td>
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<tr>
<td>F. Performance Testing</td>
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</tr>
<tr>
<td>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.</td>
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<tr>
<td>2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.</td>
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</tbody>
</table>
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
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

* 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.


### 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.

<table>
<thead>
<tr>
<th>Topic</th>
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<tbody>
<tr>
<td><strong>Session I. Socket Weld Fittings and Materials</strong></td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Socket Weld Pipe Materials</td>
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<tr>
<td>C. Socket Weld Pipe Fittings</td>
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<tr>
<td>D. Socket Weld Flanges</td>
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<tr>
<td>E. Laboratory</td>
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</tr>
<tr>
<td>Have trainees practice identifying socket weld fittings. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td><strong>Session II. Socket Weld Drawings</strong></td>
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<tr>
<td>A. Double- and Single-Line Drawings</td>
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<tr>
<td>B. Isometric Drawings</td>
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<tr>
<td>C. Piping Symbols</td>
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<tr>
<td>D. Line Numbers and Specifications Book</td>
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<tr>
<td>E. Laboratory</td>
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</tr>
<tr>
<td>Have trainees practice reading and interpreting socket weld drawings. This laboratory corresponds to Performance Task 2.</td>
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</tbody>
</table>
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
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
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.


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.

<table>
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<tr>
<th>Topic</th>
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<tr>
<td><strong>Session I. Introduction; Butt Weld Piping Materials; Butt Weld Fittings</strong>&lt;br&gt;A. Introduction</td>
<td>____________</td>
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<tr>
<td>B. Butt Weld Piping Materials</td>
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<tr>
<td>C. Butt Weld Fittings</td>
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<tr>
<td>D. Laboratory</td>
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<tr>
<td>Have trainees practice identifying butt weld fittings. This laboratory corresponds to Performance Task 1.</td>
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</tbody>
</table>
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
   Have trainees practice installing backing rings.
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

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.


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.

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


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 2 1/2 hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 12 1/2 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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td>Session I. Introduction; Air Carbon Arc Cutting (CAC-A) Process and Equipment</td>
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<tr>
<td>A. Introduction</td>
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<td>B. CAC-A Process</td>
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<td>C. CAC-A Equipment</td>
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<tr>
<td>Session II. Selection and Installation of CAC-A Electrodes</td>
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<tr>
<td>A. CAC-A Electrodes</td>
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<td>B. Electrode Selection</td>
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<td>C. Electrode Installation</td>
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<tr>
<td>D. Laboratory</td>
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<tr>
<td>Have trainees practice selecting and installing electrodes. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>Session III. Preparing Work Area and CAC-A Equipment</td>
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<tr>
<td>A. Preparing Work Area for CAC-A</td>
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<tr>
<td>B. Setting Up CAC-A Equipment</td>
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<td>C. Test Operating CAC-A Equipment</td>
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<tr>
<td>D. Laboratory</td>
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<tr>
<td>Have trainees practice setting up the work area and the CAC-A equipment. This laboratory corresponds to Performance Task 2.</td>
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</tbody>
</table>
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.