Module Overview

This module explains the types of boilers and the various applications in which they are used. The module also introduces the main components of a boiler and describes the career opportunities available to boilermakers.

Prerequisites

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

Objectives

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

1. List the common uses of boilers in industry today.
2. Describe the career opportunities available to a boilermaker.
3. Identify the tasks performed by a typical boilermaker.
4. Define several key terms used in the field of boilermaking.
5. Identify common components of boiler systems and state their functions.

Performance Tasks

This is a knowledge-based module. There are no Performance Tasks.

Materials and Equipment

<table>
<thead>
<tr>
<th>Markers/chalk</th>
<th>Desktop or laptop computer</th>
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<tbody>
<tr>
<td>Pencils and scratch paper</td>
<td>Appropriate personal protective equipment</td>
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<td>Whiteboard/chalkboard</td>
<td>Tube wall section</td>
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<tr>
<td>Boilermaking Level 1</td>
<td>Copies of the Quick Quiz*</td>
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<tr>
<td>Multimedia projector and screen</td>
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* Located at the back of this module
** Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require the trainees to visit facilities where boiler equipment is in use. Emphasize the special safety precautions associated with operating boiler equipment. Ensure that trainees are briefed on the proper site or shop safety procedures.
Additional Resources

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.


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 10 hours are suggested to cover *Introduction to Boilermaking*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<td>B. Uses of Boilers in Industry</td>
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<td>1. Power Generation</td>
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<td>2. Petroleum Refining</td>
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<td>3. Heating</td>
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<td>4. Paper Manufacturing</td>
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<td>5. Marine Boilers</td>
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<td>C. Boiler Types</td>
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<td>5. Radiant Boilers</td>
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<td>6. Universal-Pressure Boilers</td>
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<td>4. Economizer</td>
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<td>5. Soot Blowers</td>
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<td>6. Air Heater and Combustion Air Fans</td>
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<td>7. Blowdown System</td>
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<tr>
<td>B. Pollution Control Equipment</td>
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<td>1. Electrostatic Precipitator</td>
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<td>2. Mechanical Dust Collector</td>
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<td>3. Bag House</td>
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<td>5. Selective Catalytic Reduction (SCR)</td>
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</table>
Session III. Career Opportunities; Work Performed by Boilermakers

A. Career Opportunities
   1. New Construction
   2. Maintenance
   3. Operations
   4. Inspections
   5. Fabrication
   6. Contractor vs. Owner/Client Positions

B. Work Performed by Boilermakers
   1. Rigging
   2. Pipefitting/Tubefitting
   3. Welding
   4. Weld Preparation
   5. Grinding/Cutting
   6. Equipment Installation
   7. System Testing/Inspection

Session IV. Standardized Training by NCCER; Review and Testing

A. Standardized Training by NCCER
   1. Apprenticeship Training
   2. Youth Training and Apprenticeship Programs

B. Module Review

C. 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.
Module Overview

This module presents the safety equipment and safety procedures that must be followed by personnel working on boilers and boiler auxiliaries.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Boilermaking Level One, Module 34101-10.

Objectives

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

1. List the specific hazards associated with the boilermaking field.
2. Describe the respiratory hazards encountered by boilermakers.
3. Identify the hazards associated with working at heights.
4. Describe the equipment used to work at heights and identify the certification requirements needed to operate that equipment.
5. Explain the roles of general and plant-specific safety procedures and explain the contractor-client relationship as it relates to safety.

Performance Tasks

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

1. Properly put on a safety harness.
2. Select and inspect the proper PPE required for a given hazard identified by the instructor.
3. Complete a hazard analysis for a given work situation identified by the instructor.

Materials and Equipment List

- Markers/chalk
- Pencils and scratch paper
- Whiteboard/chalkboard
- Multimedia projector and screen

- Desktop or laptop computer
- Appropriate personal protective equipment
- Safety harness and lanyard
- Copies of the Quick Quiz*
- Module Examinations**
- Performance Profile Sheets**

* Located at the back of this module
**Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require the trainees to visit facilities where boiler equipment is in use. Emphasize the special safety precautions associated with boiler equipment. Ensure that trainees are briefed on the proper site or shop safety procedures.
Additional Resources

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

www.asbestoseffects.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 12½ hours are suggested to cover *Boilermaking Safety*. 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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<td><strong>Session I. Introduction; Specific Hazards Associated with Boilermaking</strong></td>
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<td>A. Introduction</td>
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<td>B. Specific Hazards Associated with Boilermaking</td>
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<td>1. Extreme Temperatures</td>
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<td>2. Extreme Pressures</td>
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<td>4. Flammable/Combustible Gases</td>
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<td>5. Crush Hazards</td>
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<td>6. Chemical Exposures</td>
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<td>B. Non-Asbestos Insulation</td>
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<td>C. Lead-Based Paint</td>
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<td>D. Confined Space Entry</td>
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<td>E. Welding-Related Respiratory Hazards</td>
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<td><strong>Session III. Working at Heights</strong></td>
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<td>A. Safety Harness</td>
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<td>B. Laboratory</td>
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<tr>
<td>Have trainees demonstrate their ability to put on a safety harness. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>C. Scissors Lifts</td>
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<td>D. Personnel Lifts</td>
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<td>E. Suspended Scaffolds</td>
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<tr>
<td>F. Certification Requirements</td>
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</tbody>
</table>
Session IV. Site Safety Procedures

A. Contractor/Client Safety Relationship

B. Laboratory

Have trainees select and inspect the proper PPE required for a given hazard identified by the instructor. This laboratory corresponds to Performance Task 2.

C. Laboratory

Have trainees complete a hazard analysis for a given work situation identified by the instructor. This laboratory corresponds to Performance Task 3.

D. Plant-Specific Alarms and Warnings

Session V. 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 the 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 hand and power tools that are used by boilermakers during the installation and maintenance of boilers. On completion of this module, the trainee should be able to identify the tools that would be used in common installation and maintenance activities.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Boilermaking Level One, Modules 34101-10 and 34102-10.

Objectives

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

1. List the safety precautions associated with:
   • Hand tools
   • Electric tools
   • Pneumatic tools
   • Hydraulic tools
2. Identify tools used by boilermakers:
   • Hand tools
   • Electrical tools
   • Pneumatic tools
   • Hydraulic tools
3. Select the tools required for given applications.

Performance Tasks

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

1. Select the tools required for given applications to be determined by the instructor:
   • Hand tools
   • Electric tools
   • Pneumatic tools
   • Hydraulic tools

Materials and Equipment List

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Boilermaking Level 1
   PowerPoint® Presentation Slides
Multimedia projector and screen
Desktop or laptop computer
Appropriate personal protective equipment
Grinding wheel
Selection of boilermaker tools for performance testing
Tubing benders
Pipe threading machine
Pipe vise or pipe stand
Laser level
Center finder
Hi-Lo gauge
Ratchet-lever hoist or come-along
Lengths of pipe and tubing
Copies of the Quick Quiz*
Module Examinations**
Performance Profile Sheets**

* Located in the back of this module
** Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require the trainees to visit facilities where boiler equipment is in use. Emphasize the special safety precautions associated with the use of hand tools and power tools. Ensure that trainees are briefed on the proper site or shop safety procedures.

Additional Resources

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.


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 Boilermaking Tools. 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><strong>Session I. Introduction; Hand Tools, Part One</strong></td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Hand Tools</td>
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<tr>
<td>1. Pipe Wrenches</td>
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<td>2. Vises and Stands</td>
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<td>3. Levels</td>
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<td>4. Squares</td>
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<td>5. Center Finders</td>
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<td>6. Pipe Line-Up Clamp</td>
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<td>7. Hi-Lo Gauges</td>
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<td>8. Wraparounds</td>
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<td>9. Drift Pins</td>
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<td>10. Two-Hole Pins</td>
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<tr>
<td><strong>Session II. Hand Tools, Part Two</strong></td>
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<tr>
<td>A. Hand Tools (continued)</td>
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<tr>
<td>1. Flange Spreaders</td>
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<td>2. Hacksaws</td>
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<td>3. Tube and Pipe Cutters</td>
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<td>5. Pipe Threading Machine</td>
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<td>6. Hand Pipe and Bolt Threaders</td>
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<td>7. Pipe Extractors</td>
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<td>8. Pipe Taps</td>
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<td>9. Bending Tools</td>
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<td>10. Ratchet-Lever Hoists and Come-Alongs</td>
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</table>
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   A. Pneumatic Tool Safety
   B. Pneumatic Tool Air Systems
   C. Pneumatic Tools
      1. Air Needle Scaler
      2. Pneumatic Hammer
      3. Pneumatic Side Grinder
      4. Tube Beveler
      5. Tube Roller/Expander
      6. Panel Saw
      7. Impact Wrench
      8. Air Tuggers

Session IV. Electric Tools
   A. Electrical Tool Safety
   B. Step-Down Transformer
   C. Handheld Saw (Circular Saw)
   D. Chop Saw
   D. Portable Band Saw
   E. Electric Grinders
   F. Drills

Session V. Hydraulic Tools
   A. Hydraulic Power Tool Safety
   B. HydroSwage®
   C. Porta-Power
   D. Hydraulic Torque Wrench
   E. Hydraulic Flange Spreader

Session VI. Laboratory; Review and Testing
   A. Laboratory
      Have trainees select boilermaking tools required for given applications to be
determined by the instructor. This laboratory corresponds to Performance Task 1.
   B. Module Review
   C. 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.
   D. Performance Testing
      1. Trainees must perform each task to the satisfaction of the instructor to receive
         recognition from the 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 presents the special materials that are used in the construction of boilers.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Boilermaking Level One, Modules 34101-10 through 34103-10.

Objectives

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

1. Describe materials used in boiler construction and explain where these materials are used.
2. Describe the different types of iron and steel.
3. Identify codes and markings used in material identification.
4. Describe material properties of the refractory, insulation, and ceramic material used in boiler construction.

Performance Tasks

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

1. Given examples of different material markings, properly identify the product.
2. Given samples of the following products, measure the sample and record the correct ASTM marking for each sample:
   • Plate steel
   • Sheet steel
   • Bar steel (various shapes)
   • Angle steel
   • Channel steel
   • Beam steel
   • Pipe (with table provided)
   • Tubing (round product, not structural)

Materials and Equipment List

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Boilermaking Level 1
   PowerPoint® Presentation Slides
Multimedia projector and screen
Desktop or laptop computer
Appropriate personal protective equipment

Samples of material used in boiler construction:
   • Plate steel
   • Sheet steel
   • Bar steel (various shapes)
   • Angle steel
   • Channel steel
   • Beam steel
   • Pipe of various sizes
   • Tubing (round product, not structural)
Copies of the Quick Quiz*
Module Examinations**
Performance Profile Sheets**

* Located in the back of this module
**Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require the trainees to visit facilities where boiler equipment is in use. Emphasize the special safety precautions associated with operating boiler equipment. Ensure that trainees are briefed on the proper site or shop safety procedures.

Additional Resources

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.


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 10 hours are suggested to cover Basic Materials. 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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<td>A. Introduction</td>
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<td>B. Important Material Physical Properties</td>
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<td>1. Chemical Composition</td>
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<td>2. Density</td>
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<td>3. Heat Transfer Rates</td>
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<td>4. Thermal Expansion</td>
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<td>5. Melting Point</td>
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<td>7. Mechanical Properties</td>
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<td>A. Ferrous Metals</td>
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<td>B. Steel and Steel Alloys</td>
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<td>1. Stainless Steel Classification</td>
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<td>2. Unified Numbering System</td>
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<td>C. Heat Number</td>
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<td>D. Standardization for the Boilermaker Trade</td>
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<td>E. Markings/Identification</td>
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<td>Session III. Structural Steel and Common Milled Shapes</td>
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<td>A. Structural Steel Classifications</td>
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<td>B. Cladding</td>
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Session IV. Insulating Materials; Review and Testing

A. Mineral Wool
B. Calcium Silicate
C. Cellular Glass
D. Fiberglass
E. Perlite
F. High-Temperature Insulating Cement
G. Refractories
H. Module Review
I. 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.
J. 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 teaches principles of safe oxyfuel cutting. Setup, care, and maintenance are covered, as well as procedures and methods for performing various types of oxyfuel cuts.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Boilermaking Level One, Modules 34101-10 through 34104-10.

Objectives

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

1. State safety precautions associated with oxyfuel cutting.
2. Identify and explain oxyfuel equipment components.
3. Explain and demonstrate how to set up, light, and adjust oxyfuel equipment.
4. Explain and demonstrate how to shut down, disassemble, and change out oxyfuel equipment.
5. Describe and demonstrate the steps needed to perform specific oxyfuel cutting tasks:
   - Straight line and square shapes
   - Piercing and slot cutting
   - Bevels
   - Washing
6. Describe the operation of motorized, portable oxyfuel cutting machines.

Performance Tasks

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

1. Set up oxyfuel equipment and light, adjust, and shut off an oxyfuel torch.
2. Shut down and disassemble oxyfuel equipment, and change cylinders.
3. Operate oxyfuel cutting equipment to perform the following on various thicknesses of steel:
   - Piercing
   - Making a straight-line cut
   - Making a square shape
   - Beveling an edge
   - Washing

Materials And Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Boilermaking Level 1 PowerPoint® Presentation Slides (ISBN 9780132137881)
Multimedia projector and screen
Desktop or laptop computer
Appropriate personal protective equipment
Sample goggles and face shields
Examples of air-purifying respirators, SARs, and SCBAs
Sample confined space and hot work permits
Oxygen cylinder (with cap)
Fuel gas cylinder (with cap)
A selection of cylinder caps
Extra empty cylinders
Regulators (oxygen and fuel gas)
Extra regulators with check valves and flashback arrestors
Hose set
A selection of usable and non-usuable hoses
Combination cutting torch
One-piece cutting torch
Assorted torch nozzles (cutting, washing, gouging)
Welding/cutting screens
Cylinder cart

(continued)
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 the handling and use of cylinders and oxyfuel cutting equipment. Ensure that trainees are briefed on shop safety procedures.

Additional Resources

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional material for continued education rather than for task training.


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 17 1/2 hours are suggested to cover Oxyfuel Cutting. You will need to adjust the time required for testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td><strong>Session I. Introduction; Oxyfuel Cutting Safety; Oxyfuel Cutting Equipment, Part One</strong></td>
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<tr>
<td>A. Introduction</td>
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<td>B. Oxyfuel Cutting Safety</td>
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<td>1. Protective Clothing and Equipment</td>
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<td>2. Ventilation</td>
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<td>3. Respirators</td>
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<td>4. Confined Space Permits</td>
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<td>5. Area Safety</td>
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<td>6. Hot Work Permits and Fire Watches</td>
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<td>7. Cutting Containers</td>
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<tr>
<td>8. Cylinder Storage and Handling</td>
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</table>

* Located at the back of this module
** Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.
C. Oxyfuel Cutting Equipment
   1. Oxygen
   2. Acetylene
   3. Liquefied Fuel Gases
   4. Regulators
   5. Hoses

Session II. Oxyfuel Cutting Equipment, Part Two
   A. Cutting Torches
   B. Cutting Torch Tips
   C. Tip Cleaners and Tip Drills
   D. Friction Lighters
   E. Cylinder Cart
   F. Soapstone Markers
   G. Specialized Cutting Equipment

Session III. Setting Up Oxyfuel Equipment; Controlling the Oxyfuel Torch Flame
   A. Setting Up Oxyfuel Equipment
      1. Transporting and Securing Cylinders
      2. Cracking Cylinder Valves
      3. Attaching Regulators
      4. Installing Flashback Arrestors or Check Valves
      5. Connecting Hoses to Regulators
      6. Attaching Hoses to the Torch
      7. Connecting Cutting Attachments (Combination Torch Only)
      8. Installing Cutting Tips
      9. Closing Torch Valves and Loosening Regulator Adjusting Screws
     10. Opening Cylinder Valves
     11. Purging the Torch and Setting the Working Pressures
     12. Testing for Leaks
   B. Controlling the Oxyfuel Torch Flame
      1. Oxyfuel Flames
      2. Backfires and Flashbacks
      3. Igniting the Torch and Adjusting the Flame
      4. Shutting Off the Torch

Session IV. Shutting Down Oxyfuel Cutting Equipment; Disassembling Oxyfuel Equipment; Changing Empty Cylinders
   A. Shutting Down Oxyfuel Cutting Equipment
   B. Disassembling Oxyfuel Equipment
   C. Changing Empty Cylinders
   D. Laboratory
      Have trainees set up, ignite, adjust, shut down, and disassemble oxyfuel equipment, as well as change cylinders. This laboratory corresponds to Performance Tasks 1 and 2.
Session V. Performing Cutting Procedures; Motorized Oxyfuel Machine Cutting Operation

A. Performing Cutting Procedures
   1. Inspecting the Cut
   2. Preparing for Oxyfuel Cutting with a Hand Cutting Torch
   3. Cutting Thin Steel
   4. Cutting Thick Steel
   5. Piercing a Plate
   6. Cutting Bevels
   7. Oxyfuel Performance Tasks
   8. Washing

B. Motorized Oxyfuel Cutting Machine Operations
   1. Machine Controls
   2. Torch Adjustment
   3. Straight-Line Cutting
   4. Bevel Cutting

C. Laboratory
   Allow trainees to practice straight-line cutting and bevel cutting with an oxyfuel machine.

Session VI.

A. Laboratory
   Have trainees perform piercing, straight-line cutting, square shape cutting, bevel cutting, and washing. This laboratory corresponds to Performance Task 3.

Session VII. 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 complete each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the performance testing requirements.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
Module Overview

This module introduces types of gaskets and gasket material, types of packing and packing material, and types of O-ring material. It also explains the use and choice of gaskets, packing, and O-rings, and teaches how to fabricate a gasket.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Boilermaking Level One, Modules 34101-10 through 34105-10.

Objectives

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

1. Identify and explain gasket types.
2. Identify and explain gasket materials.
3. Lay out and cut gaskets.
4. Install gaskets.

Performance Tasks

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

1. Perform a takeoff from a flange.
2. Lay out the gasket on gasket material.
3. Cut the gasket inside and outside diameters to the proper size ±1⁄16 of an inch.
4. Cut the bolt holes to the proper size ±1⁄6 of an inch.
5. Install the gasket and flange bolts.
6. Tighten the flange bolts to the proper torque and in the proper sequence.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Boilermaking Level 1
  PowerPoint® Presentation Slides
Multimedia projector and screen
Desktop or laptop computer
Appropriate personal protective equipment
Assorted gaskets including as many of the following types as is feasible: ring, spiral-wound, full-face, jacketed, envelope, split-ring, strip
Gasket manufacturer’s literature including color coding chart
Pump manufacturer’s literature specifying replacement gaskets
Samples of gaskets made of different materials (silicon, Viton®, EPDM, neoprene, nitrile)
Hand tools for measuring and cutting gaskets:
  Dividers
  Scribers
  Steel rules
  Adjustable gasket cutters
  Hole punch sets
  Mallets
Compasses with an ink pen holder and ink pens with silver or white ink
Gasket materials or old rubber inner tubes that can be cut up as substitute gasket material
Various types of packing (Teflon® yarn and filament, graphite yarn, carbon yarn, TFE)
Packing pullers
Old appliances, pumps, or valves with packing seals
Sheet metal
Tin snips
Bluing

(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 fabricate and install gaskets. Ensure that all trainees are briefed on hand tool safety and have appropriate personal protection equipment.

Additional Resources

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.


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 Cutting and Fitting Gaskets. 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; Types of Gaskets; Gasket Materials</td>
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<td>A. Introduction</td>
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<tr>
<td>1. Compatibility</td>
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<td>B. Types of Gaskets</td>
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<tr>
<td>1. Ring Gaskets</td>
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<td>2. Spiral-Wound Gaskets</td>
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<td>3. Full-Face Gaskets</td>
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<td>4. Jacketed Gaskets</td>
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<td>5. Envelope Gaskets</td>
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<td>6. Split-Ring Gaskets</td>
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<td>7. Strip Gaskets</td>
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</tbody>
</table>
C. Gasket Materials  
1. Natural Rubber  
2. EPDM  
3. Neoprene  
4. Nitrile  
5. Silicone  
6. Viton®  
7. Gylon® or Amerilon®  
8. Graphite Impregnated Gaskets  
9. Ring-Type Joint Gaskets  
10. Soft Metal Gaskets  

Session II. Fabricating Gaskets  
A. Laying Out a New Gasket  
B. Tracing a Gasket  
C. Machine Gaskets  
D. Laboratory  
   Have trainees practice fabricating a gasket. This laboratory corresponds to Performance Tasks 1–4.  

Session III. Installing Gaskets  
A. Installing Gaskets  
B. Laboratory  
   Have trainees practice installing gaskets and tightening flange bolts. This laboratory corresponds to Performance Tasks 5 and 6.  

Session IV. Packing; Packing Configurations; Removing and Installing Packings; O-Rings  
A. Packing  
   1. Teflon® Yarn Packing  
   2. Teflon® Filament Packing  
   3. Lubricated Graphite Yarn Packing  
   4. Lubricated Carbon Yarn Packing  
   5. TFE/Synthetic Fiber Packing  
B. Packing Configurations  
   1. Square-Braid Packing  
   2. Braid-Over-Braid Packing  
   3. Interlocking Braid Packing  
   4. Twisted Packing  
   5. Multicore Braid Packing  
   6. Metal Packings  
   7. Graphite Ribbon Packing  
   8. Lip-Type Packings  
   9. Die Cut Packing  
C. Removing and Installing Packings  
D. Laboratory  
   Have trainees practice installing packings.
E. O-Rings
   1. Buna-N O-Rings
   2. Ethylene Propylene O-Rings
   3. Viton® O-Rings
   4. Teflon® O-Rings
   5. Silicone O-Rings
   6. Teflon®-Encapsulated Silicone O-Rings
   7. Polyurethane O-Rings
   8. Removing and Installing O-Rings

F. Laboratory
   Have trainees practice installing an O-ring.

Session V. 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 teaches how to clean base metals for welding and cutting, how to identify and explain joint design, and how to prepare base metal joints for welding.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Boilermaking Level One, Modules 34101-10 through 34106-10.

Objectives

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

1. Clean base metal for welding or cutting.
2. Mechanically bevel the edge of a mild steel plate.
3. Thermally bevel the end of a mild steel plate.

Performance Tasks

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

1. Clean base metal for welding or cutting using the correct tools.
2. Mechanically bevel the edge of a mild steel plate per instructor’s specifications.
3. Thermally bevel the end of a mild steel plate per instructor’s specifications.

Materials And Equipment

- Markers/chalk
- Pencils and scratch paper
- Whiteboard/chalkboard
- Multimedia projector and screen
- Desktop or laptop computer
- Appropriate personal protective equipment
- Full face shields
- Examples (photos or actual objects) of metals that have and have not been prepared for welding
- Examples of surface corrosion on different metals
- Examples of defects caused by surface contamination
- MSDSs for metal cleaning chemicals
- Examples of welding drawings and welding procedure specifications
- An oxyfuel or plasma arc system or pictures showing how these systems can be used for joint preparation
- Properly beveled coupons
- Chipping hammer
- Soapstone
- Tape measure
- Pliers
- Files
- Framing square
- Combination square with protractor head
- Hand scrapers and wire brushes
- Power grinder with grinding and wire brush attachments
- Mechanical beveling equipment for plate
- Thermal beveling equipment for plate
- Copies of the Quick Quiz*
- Module Examinations**

* Located in the back of this module
**Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize any special safety precautions associated with cutting and shaping metal 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 is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

- *OSHA Standard 1926.351, Arc Welding and Cutting*  
  www.lincolnelectric.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 10 hours are suggested to cover Base Metal Preparation. You will need to adjust the time required for testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

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<thead>
<tr>
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<td><strong>Session I. Introduction; Basic Welding Safety; Base Metal Cleaning</strong></td>
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<td>A. Introduction</td>
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<tr>
<td>B. Basic Welding Safety</td>
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<tr>
<td>1. Protective Clothing and Equipment for Preparing Metals</td>
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<tr>
<td>2. Fire/Explosion Prevention</td>
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<td>3. Work Area Ventilation</td>
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<td>C. Base Metal Cleaning</td>
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<tr>
<td>1. Surface Corrosion</td>
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<td>2. Defects Caused by Surface Contamination</td>
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<tr>
<td>3. Mechanical Cleaning</td>
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<td>4. Chemical Cleaning</td>
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<td>D. Laboratory</td>
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<tr>
<td>Have trainees practice cleaning base metal for welding and cutting. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td><strong>Session II. Welding Joint Preparation</strong></td>
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<tr>
<td>A. Identify Joint Specification</td>
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<td>B. Mechanical Joint Preparation</td>
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<td>C. Thermal Joint Preparation</td>
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</table>
Session III. Laboratory
A. Laboratory
   Have trainees practice beveling steel plate by mechanical means. This laboratory corresponds to Performance Task 2.
B. Thermal Joint Preparation

Session IV. Laboratory; Review and Testing
A. Laboratory
   Have trainees practice beveling steel plate by thermal means. This laboratory corresponds to Performance Task 3.
B. Module Review
C. 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.
D. Performance Testing
   1. Trainees must complete each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the performance testing requirements.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
Module Overview

This module introduces the boilermaker trainee to the equipment, tools, methods, and safety practices associated with the welding and cutting of metals.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum and Boilermaking Level One, Modules 34101-10 through 34107-10.

Objectives

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

1. Identify the different welding processes and welding equipment commonly used in boiler work.
2. Set up a shield-gas purge on a pipe to be welded.
3. Identify the specialized personal protective equipment needed when performing welding and demonstrate the ability to use this equipment properly.
4. Identify the specific safety hazards associated with welding and cutting in a boiler environment.
5. Identify the types of welding joints, their critical dimensions, and their applications.
6. State the criteria used to select the electrodes and filler metals used on boiler equipment.
7. Properly receive, store, and care for welding electrodes and filler metal.
8. Identify the different code requirements that apply to the construction and maintenance of boilers.
9. Explain the different qualification and certification requirements that apply to welders working on a boiler.
10. Identify welding rods and/or filler metals by their markings.
11. Explain joint design and the factors that must be considered when determining the type of weld to be used.

Performance Tasks

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

1. Identify welding rods and/or filler metal by their associated markings.
2. Set up a shielding gas purge on a section of piping or tubing.
3. Identify welding equipment associated with different welding procedures.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Multimedia projector and screen
Desktop or laptop computer
Appropriate personal protective equipment, to include:
  Gloves
  Face shield
  Ear plugs
  Welding cap
  Spats

Example of a hot work permit
Samples of backing tape
Welding machines and equipment
Selection of filler metal for:
  SMAW
  GTAW
  GMAW
  FCAW

Boiler Pressure Vessel Code B31.1
Copies of the Quick Quiz*
Module Examinations**
Performance Profile Sheets**

* Located in the back of this module
** Available on the IRC (Instructor Resource Center) at www.NCCERContrenIRC.com using the access code supplied with the Annotated Instructor’s Guide.
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require the trainees to visit facilities where welding work is being performed. Emphasize the special safety precautions associated with arc welding and cutting procedures. Ensure that trainees are briefed on the proper site or shop safety procedures.

Additional Resources

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

OSHA Standard 1926.351, Arc Welding and Cutting.
www.lincolnelectric.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 22½ hours are suggested to cover Welding Basics. 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>A. Introduction</td>
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<td>B. Welding and Cutting Processes</td>
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<tr>
<td>1. Shielded Metal Arc Welding (SMAW)</td>
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<td>2. GMAW/FCAW</td>
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<td>3. GTAW</td>
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<td>4. Plasma Arc Cutting Process</td>
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<td>5. Air Carbon Arc Cutting Process</td>
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<td>6. Shielding Gas</td>
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<td><strong>Session II. Safety</strong></td>
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<td>A. Personal Protective Equipment</td>
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<td>B. Ventilation</td>
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<td>C. Hot Work Permits and Fire Watches</td>
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<td>D. Cutting Containers</td>
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<td>E. Oxygen Hazards</td>
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<td>F. Electrical Safety</td>
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Session III. SMAW Electrodes; Selecting SMAW Electrodes; SMAW Filler Metals Storage and Control
A. SMAW Electrodes
   1. AWS Filler Metal Specification System
   2. Electrode Classification System
   3. Manufacturers’ Classification
   4. Electrode Sizes
B. Selecting SMAW Electrodes
   1. Electrode Groups
   2. Electrode Selection Considerations
C. SMAW Filler Metals Storage and Control
   1. Code Requirements
   2. Receiving Filler Metal
   3. Storing Filler Metal
   4. Storage Ovens

Session IV. GTAW and GMAW Filler Metals; FCAW Electrodes; Filler Metal Traceability Requirements
A. GTAW Filler Metals
B. GMAW Filler Metals
   1. Classification System
   2. Storage
C. FCAW Electrodes
D. Filler Metal Traceability Requirements
E. Laboratory
   Have trainees practice identifying welding rods and/or filler metals by their markings. This laboratory corresponds to Performance Task 1.

Session V. Joint Design
A. Load Considerations
B. Types of Joint
C. Types of Welds
D. Welding Position
E. Codes and Welding Procedure Specifications

Session VI. Arc Welding Machines
A. Transformer Welding Machines
B. Transformer-Rectifier Welding Machines
C. Engine-Driven Generator and Alternator Machines

Session VII. Laboratory
A. Laboratory
   1. Have trainees practice identifying welding equipment associated with different welding procedures. This laboratory corresponds to Performance Task 3.
B. Laboratory
   2. Have trainees practice setting up a shielding gas purge on a section of piping or tubing. This laboratory corresponds to Performance Task 2.
Session VIII. Codes Governing Welding
A. American Society of Mechanical Engineers
B. American Welding Society
C. American Petroleum Institute
D. American National Standards Institute
E. Basic Elements of Welding Codes

Session IX. 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 the 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.