

# Introduction to Boilermaking 34101-10

## 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

Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

Boilermaking Level 1

PowerPoint® Presentation Slides  
(ISBN 978-0-13-213788-1)

Multimedia projector and screen

Desktop or laptop computer

Appropriate personal protective equipment

Tube wall section

Copies of the Quick Quiz\*

Module Examinations\*\*

\* Located at the back of this module

\*\* Available on the IRC (Instructor Resource Center) at 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.

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

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

## Teaching Time For This Module

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

Topic	Planned Time
Session I. Introduction; Use of Boilers in Industry; Boiler Types	
A. Introduction	
B. Uses of Boilers in Industry	
1. Power Generation	
2. Petroleum Refining	
3. Heating	
4. Paper Manufacturing	
5. Marine Boilers	
6. Co-Generation	
C. Boiler Types	
1. Fluidized Bed Boilers	
2. Recovery Boilers	
3. Heat Recovery Steam Generator (HRSG)	
4. Package Boilers	
5. Radiant Boilers	
6. Universal-Pressure Boilers	
Sessions II. Boiler Construction; Pollution Control Equipment	
A. Basic Boiler Construction	
1. Furnace	
2. Steam Drum	
3. Penthouse	
4. Economizer	
5. Soot Blowers	
6. Air Heater and Combustion Air Fans	
7. Blowdown System	
B. Pollution Control Equipment	

1. Electrostatic Precipitator
2. Mechanical Dust Collector
3. Bag House
4. Scrubbers
5. Selective Catalytic Reduction (SCR)

### 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.

## Boilermaking Safety 34102-10

### 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

Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

Boilermaking Level 1

PowerPoint<sup>®</sup> Presentation Slides  
(ISBN 978-0-13-213788-1)

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 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.

*Accident Prevention and OSHA Compliance*, Latest Edition. Boca Raton, FL: CRC Press.

*Steam – Its Generation and Use*. Barberton, OH: The Babcock and Wilcox Company.

*Supervisor's Safety Manual: Better Production Without Injury and Waste from Accidents*, 8th Revision. Itasca, IL: National Safety Council.

[www.asbestoseffects.com](http://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.

### Topic

### Planned Time

#### **Session I. Introduction; Specific Hazards Associated with Boilermaking**

- A. Introduction
- B. Specific Hazards Associated with Boilermaking
  - 1. Extreme Temperatures
  - 2. Extreme Pressures
  - 3. Combustion Residue Buildup
  - 4. Flammable/Combustible Gases
  - 5. Crush Hazards
  - 6. Chemical Exposures

#### **Session II. Respiratory Hazards**

- A. Asbestos Insulation
- B. Non-Asbestos Insulation
- C. Lead-Based Paint
- D. Confined Space Entry
- E. Welding-Related Respiratory Hazards

#### **Session III. Working at Heights**

- A. Safety Harness
- B.

Laboratory

Have trainees demonstrate their ability to put on a safety harness. This laboratory corresponds to Performance Task 1.

- C. Scissors Lifts
- D. Personnel Lifts
- E. Suspended Scaffolds
- F. Certification Requirements

#### **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.

## Boilermaking Tools 34103-10

### 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

Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

Boilermaking Level 1

PowerPoint<sup>®</sup> Presentation Slides  
(ISBN 978-0-13-213788-1)

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 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.

*Guide to Hand Tools: Selection, Safety Tips, Proper Use and Care*, Latest Edition. Tarrytown, NY: Hand Tools Institute.

*Tools and Their Uses*, 1981. Washington, DC: Naval Education and Training Program Development Center, U.S. Government Printing Office.

## 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.

### Topic

### Planned Time

#### Session I. Introduction; Hand Tools, Part One

- A. Introduction
- B. Hand Tools
  - 1. Pipe Wrenches
  - 2. Vises and Stands
  - 3. Levels
  - 4. Squares
  - 5. Center Finders
  - 6. Pipe Line-Up Clamp



7. Hi-Lo Gauges
8. Wraparounds
9. Drift Pins
10. Two-Hole Pins

## **Session II. Hand Tools, Part Two**

- A. Hand Tools (continued)
  1. Flange Spreaders
  2. Hacksaws
  3. Tube and Pipe Cutters
  4. Manual Pipe Reamers
  5. Pipe Threading Machine
  6. Hand Pipe and Bolt Threaders
  7. Pipe Extractors
  8. Pipe Taps
  9. Bending Tools
  10. Ratchet-Lever Hoists and Come-Alongs

## **Session III. Pneumatic Tools**

- 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<sup>®</sup>
- 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.

## Basic Materials 34104-10

### 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

Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

Boilermaking Level 1

PowerPoint<sup>®</sup> Presentation Slides  
(ISBN 978-0-13-213788-1)

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 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.

*Metallurgy for the Non-Metallurgist*, Latest Edition. Materials Park, OH: ASM International.

*Welding Level One Trainee Guide*, Latest Edition. Upper Saddle River, NJ: Prentice Hall.

*Worldwide Guide to Equivalent Irons and Steels*, Latest Edition. Materials Park, OH: ASM International.

## 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 *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.

### Topic

### Planned Time

#### **Session I. Introduction; Important Material Physical Properties**

- A. Introduction
- B. Important Material Physical Properties
  1. Chemical Composition
  2. Density
  3. Heat Transfer Rates
  4. Thermal Expansion
  5. Melting Point
  6. Corrosion Resistance

## 7. Mechanical Properties

### **Session II. Metals Used in the Construction of Boilers**

- A. Ferrous Metals
- B. Steel and Steel Alloys
  - 1. Stainless Steel Classification
  - 2. Unified Numbering System
- C. Heat Number
- D. Standardization for the Boilermaker Trade
- E. Markings/Identification

### **Session III. Structural Steel and Common Milled Shapes**

- A. Structural Steel Classifications
- B. Cladding

### **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.

# Oxyfuel Cutting 34105-10

## 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-usable hoses  
Combination cutting torch  
One-piece cutting torch  
Assorted torch nozzles (cutting, washing,  
gouging)  
Welding/cutting screens  
Cylinder cart  
Motorized oxyfuel cutting equipment  
Framing squares  
Combination squares with protractor head  
Tape measure  
Soapstone  
Penknife  
Pliers  
Chipping hammers  
Friction lighters  
Torch wrenches  
Vendor cutting tip chart  
Tip cleaners, drills, and files  
Vendor-supplied videos/DVDs showing oxyfuel equipment in operation (optional)  
TV/VCR/DVD player (optional)  
Approved leak-testing solution  
Steel plate  
      Thin (16 to 10 gauge)  
      Thick (¼-inch thick to 1-inch thick)  
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 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 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.

*ANSI Z49.1, Safety in Welding, Cutting, and Allied Processes.* Miami, FL: American Welding Society.  
*Welder's Handbook*, 1997. Richard Finch. New York, NY: The Berkley Publishing Group, Inc.

## Teaching Time For This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 17½ 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.

<b>Topic</b>	<b>Planned Time</b>
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### **Session I.**

#### **Introduction; Oxyfuel Cutting Safety; Oxyfuel Cutting Equipment, Part One**

- A. Introduction
- B. Oxyfuel Cutting Safety
  - 1. Protective Clothing and Equipment
  - 2. Ventilation
  - 3. Respirators
  - 4. Confined Space Permits
  - 5. Area Safety
  - 6. Hot Work Permits and Fire Watches
  - 7. Cutting Containers
  - 8. Cylinder Storage and Handling
- 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.

## Cutting and Fitting Gaskets 34106-10

### 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  $\pm\frac{1}{16}$  of an inch.
4. Cut the bolt holes to the proper size  $\pm\frac{1}{16}$  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<sup>®</sup> Presentation Slides  
(ISBN 978-0-13-213788-1)

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<sup>®</sup>, EPDM, neoprene, nitrile)

Compasses with an ink pen holder and ink pens with silver or white ink

Hand tools for measuring and cutting gaskets:

- Dividers
- Scribers
- Steel rules
- Adjustable gasket cutters
- Hole punch sets
- Mallets

Gasket materials or old rubber inner tubes that can be cut up as substitute gasket material

Various types of packing (Teflon<sup>®</sup> yarn and filament, graphite yarn, carbon yarn, TFE)

Packing pullers

Old appliances, pumps, or valves with packing seals

Sheet metal

Tin snips

Bluing

Rags

Hand tools for assembling and disassembling valves and motors

Torque wrenches

Flanges

Assorted O-rings, including as many of the following as is feasible:

- Buna-N, ethylene propylene, Viton<sup>®</sup>,
- Teflon<sup>®</sup>, silicon, polyurethane

Packing manufacturer's literature

Copies of the Quick Quiz\*

Module Examinations\*\*

Performance Profile Sheet\*\*

\* Located in the back of this module

\*\* Available on the IRC (Instructor Resource Center) at 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 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.

*Specifications for Gaskets, O-Rings, and Packing.* Washington, DC: American National Standards Institute. (ANSI).

*Specifications for Gaskets, O-Rings, and Packing.* West Conshohocken, PA: ASTM International.

*Specifications for Gaskets, O-Rings, and Packing.* Warrendale, PA: SAE International.

## 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.

### Topic

### Planned Time

#### **Session I. Introduction; Types of Gaskets; Gasket Materials**

- A. Introduction
  - 1. Compatibility
- B. Types of Gaskets
  - 1. Ring Gaskets
  - 2. Spiral-Wound Gaskets
  - 3. Full-Face Gaskets
  - 4. Jacketed Gaskets
  - 5. Envelope Gaskets
  - 6. Split-Ring Gaskets
  - 7. Strip Gaskets
- C. Gasket Materials
  - 1. Natural Rubber
  - 2. EPDM
  - 3. Neoprene
  - 4. Nitrile
  - 5. Silicone
  - 6. Viton<sup>®</sup>
  - 7. Gylon<sup>®</sup> or Amerilon<sup>®</sup>
  - 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<sup>®</sup> Yarn Packing
2. Teflon<sup>®</sup> 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<sup>®</sup> O-Rings
4. Teflon<sup>®</sup> O-Rings
5. Silicone O-Rings
6. Teflon<sup>®</sup> -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.

## Base Metal Preparation 34107-10

### 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

Boilermaking Level 1

PowerPoint<sup>®</sup> Presentation Slides  
(ISBN 978-0-13-213788-1)

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\*\*  
Performance Profile Sheets\*\*

\* Located in the back of this module

\*\* Available on the IRC (Instructor Resource Center) at 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.

*Welding Handbook, Volume 5*, 2001. Miami, FL: The American Welding Society.

*The Procedure Handbook of Arc Welding*, 2000. Cleveland, OH: The Lincoln Electric Company.

*OSHA Standard 1926.351, Arc Welding and Cutting*

[www.lincolnelectric.com](http://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.

#### Topic

#### Planned Time

#### **Session I. Introduction; Basic Welding Safety; Base Metal Cleaning**

- A. Introduction
- B. Basic Welding Safety
  - 1. Protective Clothing and Equipment for Preparing Metals
  - 2. Fire/Explosion Prevention
  - 3. Work Area Ventilation
- C. Base Metal Cleaning
  - 1. Surface Corrosion

- 2. Defects Caused by Surface Contamination
  - 3. Mechanical Cleaning
  - 4. Chemical Cleaning
- D. Laboratory

Have trainees practice cleaning base metal for welding and cutting. This laboratory corresponds to Performance Task 1.

### **Session II. Welding Joint Preparation**

- A. Identify Joint Specification
- B. Mechanical Joint Preparation
- C. Thermal Joint Preparation

### **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.



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.