

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	Desktop or laptop computer
Pencils and scratch paper	Appropriate personal protective equipment
Whiteboard/chalkboard	Tube wall section
Boilermaking Level 1 PowerPoint® Presentation Slides (ISBN 978-0-13-213788-1)	Copies of the Quick Quiz*
Multimedia projector and screen	Module Examinations**

* 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.

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)	_____

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	Desktop or laptop computer
Pencils and scratch paper	Appropriate personal protective equipment
Whiteboard/chalkboard	Safety harness and lanyard
Boilermaking Level 1	Copies of the Quick Quiz*
PowerPoint® Presentation Slides (ISBN 978-0-13-213788-1)	Module Examinations**
Multimedia projector and screen	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.

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

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.

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	Tubing benders
Pencils and scratch paper	Pipe threading machine
Whiteboard/chalkboard	Pipe vise or pipe stand
Boilermaking Level 1	Laser level
PowerPoint® Presentation Slides (ISBN 978-0-13-213788-1)	Center finder
Multimedia projector and screen	Hi-Lo gauge
Desktop or laptop computer	Ratchet-lever hoist or come-along
Appropriate personal protective equipment	Lengths of pipe and tubing
Grinding wheel	Copies of the Quick Quiz*
Selection of boilermaker tools for performance testing	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.

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®
- 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
(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 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.

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.

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

(continued)

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 (1/4-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 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 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.

Topic	Planned Time
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	_____

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 $\pm\frac{1}{16}$ 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® 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®, 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)

Rags
 Hand tools for assembling and disassembling valves and motors
 Torque wrenches
 Flanges
 Packing manufacturer's literature

Assorted O-rings, including as many of the following as is feasible: Buna-N, ethylene propylene, Viton®, Teflon®, silicon, polyurethane)
 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 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 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	_____

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	Properly beveled coupons
Pencils and scratch paper	Chipping hammer
Whiteboard/chalkboard	Soapstone
Boilermaking Level 1 PowerPoint® Presentation Slides (ISBN 978-0-13-213788-1)	Tape measure
Multimedia projector and screen	Pliers
Desktop or laptop computer	Files
Appropriate personal protective equipment	Framing square
Full face shields	Combination square with protractor head
Examples (photos or actual objects) of metals that have and have not been prepared for welding	Hand scrapers and wire brushes
Examples of surface corrosion on different metals	Power grinder with grinding and wire brush attachments
Examples of defects caused by surface contamination	Mechanical beveling equipment for plate
MSDSs for metal cleaning chemicals	Thermal beveling equipment for plate
Examples of welding drawings and welding procedure specifications	Copies of the Quick Quiz*
An oxyfuel or plasma arc system or pictures showing how these systems can be used for joint preparation	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. 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

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.

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

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

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.

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.

Stick Electrode Welding Guide, 2004. Cleveland, OH: The Lincoln Electric Company.

Stick Electrode Product Catalog, 2008. Cleveland, OH: The Lincoln Electric Company.

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.

Topic	Planned Time
Session I. Introduction; Welding and Cutting Processes	
A. Introduction	_____
B. Welding and Cutting Processes	_____
1. Shielded Metal Arc Welding (SMAW)	_____
2. GMAW/FCAW	_____
3. GTAW	_____
4. Plasma Arc Cutting Process	_____
5. Air Carbon Arc Cutting Process	_____
6. Shielding Gas	_____
Session II. Safety	
A. Personal Protective Equipment	_____
B. Ventilation	_____
C. Hot Work Permits and Fire Watches	_____
D. Cutting Containers	_____
E. Oxygen Hazards	_____
F. Electrical Safety	_____

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.
