

Module Overview

This module, an extension of the *Core Curriculum* safety module, identifies general safety considerations that apply to welding and metal cutting. It describes the steps that must be taken to avoid job-related deaths and injuries while establishing and maintaining a safe work environment.

Prerequisites

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

Objectives

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

1. Identify some common hazards in welding.
2. Explain and identify proper personal protection used in welding.
3. Describe how to avoid welding fumes.
4. Explain some of the causes of accidents.
5. Identify and explain uses for material safety data sheets.
6. Explain safety techniques for storing and handling cylinders.
7. Explain how to avoid electric shock when welding.
8. Describe proper material handling methods.

Performance Tasks

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

Materials and Equipment List

Markers/chalk	Various welding gloves
Pencils and scratch paper	Samples of protective welding footwear
Whiteboard/chalkboard	Earplugs
Welding 1 PowerPoint® Presentation Slides (ISBN 0-13-609092-3)	Various welding and cutting helmets with face shields
Multimedia projector and screen	Welding helmet with auto-darkening lens
Desktop or laptop computer	Full-face supplied-air respirator (SAR)
Appropriate personal protective equipment	Oxyfuel gas cutting/welding equipment
Leather protective gear	Module Examinations*

*Located in the Test Booklet

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize the special safety precautions associated with welding because of the added potential for fire, burns, respiratory problems, and electrical shock. Ensure that trainees are briefed on shop safety procedures.

Additional Resources

This module 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.

Arc Welding Safety E205, Latest Edition. Cleveland, OH: Lincoln Electric.

Ventilation Guide for Weld Fumes AWS F32M/F32, Latest Edition. Miami, FL: American Welding Society.

Teaching Time for this Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 2½ hours are suggested to cover *Welding Safety*. You will need to adjust the time required for testing based on your class size and resources. There are no performance tasks for this module.

Topic	Planned Time
Session I. Introduction; Welding Safety Practices	
A. Introduction	_____
B. Welding Safety Practices	_____
C. Appropriate Personal Protective Equipment	_____
D. Fumes and Gases	_____
E. Confined Space Permits	_____
F. Area Safety	_____
G. Hot Work Permits and Fire Watches	_____
H. Oxyfuel Gas Welding and Cutting Safety	_____
I. Cutting Containers	_____
J. Cylinder Storage and Handling	_____
K. Power Tool Safety	_____
L. Electrical Safety	_____
M. Material Safety Data Sheets	_____
N. Material Handling	_____
O. Safety Planning and Emergency Action Plans	_____
P. Module Review	_____
Q. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft 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 the following: *Core Curriculum* and *Welding Level One*, Module 29101-09.

Objectives

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

1. Identify and explain the use of oxyfuel cutting equipment.
2. Set up oxyfuel equipment.
3. Light and adjust an oxyfuel torch.
4. Shut down oxyfuel cutting equipment.
5. Disassemble oxyfuel equipment.
6. Change cylinders.
7. Perform oxyfuel cutting:
 - Straight line and square shapes
 - Piercing and slot cutting
 - Bevels
 - Washing
 - Gouging
8. Operate a motorized, portable oxyfuel gas cutting machine.

Performance Tasks

1. Set up oxyfuel equipment.
2. Light and adjust an oxyfuel torch.
3. Shut down oxyfuel cutting equipment.
4. Disassemble oxyfuel equipment.
5. Change empty cylinders.
6. Cut shapes from various thicknesses of steel, emphasizing:
 - Straight line
 - Square shape
 - Piercing
 - Bevel
 - Slot
7. Perform washing.
8. Perform gouging.

Materials and Equipment List

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Welding 1 PowerPoint® Presentation Slides
(ISBN 0-13-609092-3)
Multimedia projector and screen
Desktop or laptop computer
Appropriate personal protective equipment
Oxygen cylinder (with cap)
Fuel gas cylinder (with cap)

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)

Cylinder cart
 Motorized oxyfuel track cutter
 Framing squares
 Combination squares with protractor head
 Tape measure
 Soapstone
 Penknife
 Pliers
 Chipping hammers
 Friction lighters
 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
 Wrenches (torch, hose, and regulator)
 Steel plate

- Thin (16 to 10 gauge)
- Thick (¼-inch thick to 1-inch thick)

 Module Examinations*
 Performance Profile Sheets*

*Located in the Test Booklet

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 work is suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

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

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 to Oxyfuel Safety; Oxyfuel Cutting Equipment, Part One	
A. Introduction	_____
B. Oxyfuel Safety Summary	_____
1. Protective Clothing and Equipment	_____
2. Fire/Explosion Prevention	_____
3. Work Area Ventilation	_____
C. Oxyfuel Cutting Equipment	_____
1. Oxygen	_____
2. Acetylene	_____
3. Liquefied Fuel Gases	_____
4. Regulators	_____
a. Laboratory	_____
Allow trainees to install and remove regulators from empty oxygen and gas cylinders.	
5. Hoses	_____

Session VI. Performing Cutting Procedures, Part Two; Portable Oxyfuel Cutting Machine Operation

A. Laboratory

Have trainees perform straight-line cutting, square shape cutting, piercing, slot cutting, bevel cutting, washing, and gouging. This laboratory corresponds to Performance Tasks 6 through 8.

B. Portable Oxyfuel Cutting Machine Operation

1. Torch Adjustment

2. Straight-Line Cutting

a. Laboratory

Allow trainees to practice straight-line cutting with an oxyfuel machine.

3. Bevel Cutting

a. Laboratory

Allow trainees to practice bevel cutting with an oxyfuel machine.

Session VII. Review and Testing

A. Module Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Craft 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 the NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the performance testing requirements.
2. Record the testing results on Craft Training Report Form 200 and submit the results to the Training Program Sponsor.

D. Performance Accreditation Tasks – Have trainees complete PATs 1 through 3 according to the acceptance criteria.

1. Have trainees perform PAT 1, Setting Up, Igniting, Adjusting, and Shutting Down Oxyfuel Equipment. This task corresponds to *AWS EG2.0*, Module 8 – Thermal Cutting Processes, Unit 1 – Manual OFC Principles, Key Indicators: 3 and 4.
2. Have trainees perform PAT 2, Cutting a Shape from Thin Steel. This task corresponds to *AWS EG2.0*, Module 8 – Thermal Cutting Processes, Unit 1 – Manual OFC Principles, Key Indicators: 5, 6, and 7.
3. Have trainees perform PAT 3, Cutting a Shape from Thick Steel. This task corresponds to *AWS EG2.0*, Module 8 – Thermal Cutting Processes, Unit 1 – Manual OFC Principles, Key Indicators: 5, 6, and 7.

Module Overview

This module describes plasma arc cutting equipment; safe work area preparation; plasma arc cutting methods for piercing, slotting, squaring, and beveling metals; and proper storage and housekeeping.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum* and *Welding Level One*, Modules 29101-09 and 29102-09.

Objectives

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

1. Explain the plasma arc cutting processes.
2. Identify plasma arc cutting equipment.
3. Prepare and set up plasma arc cutting equipment.
4. Use plasma arc cutting equipment to make various types of cuts.
5. Properly store equipment and clean the work area after use.

Performance Tasks

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

1. Set up plasma arc cutting equipment.
2. Set the amperage and gas pressures or flow rates for the type and thickness of metal to be cut.
3. Square-cut metal using plasma arc cutting equipment.
4. Bevel-cut metal using plasma arc equipment.
5. Pierce and cut slots in metal using plasma arc cutting equipment.
6. Dismantle and store the equipment.

Materials and Equipment List

Markers/chalk	Photographs or videos showing large industrial PAC units
Pencils and scratch paper	Bearings damaged by electric arcs
Whiteboard/chalkboard	Soapstone
Welding 1 PowerPoint® Presentation Slides (ISBN 0-13-609092-3)	Tape measure
Multimedia projector and screen	Pliers
Desktop or laptop computer	Plasma arc cutting unit with cutting torch and appropriate gas sources
Appropriate personal protective equipment	Scrap steel sheet or plate, 12 gauge to ½" thick
Leather protective gear (jacket or sleeves)	Scrap stainless steel sheet or plate, 12 gauge to ½" thick (if available)
Various welding gloves	Scrap aluminum plate, ⅜" to ½" thick (if available)
Samples of protective welding footwear	Wire brush
Earplugs	Chipping hammer
Safety glasses with approved lenses	Workpiece damaged by improper gas or current settings
Full face shields	Examples of good and bad cuts produced by plasma arc cutting
Welding shield or helmet with appropriate lens	Module Examinations*
Respirator	Performance Profile Sheets*
Examples of welding job opening postings (welding labs may post them on bulletin boards)	
Vendor manuals for PAC equipment showing cutting ratings	

*Located in the Test Booklet

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize the special safety precautions associated with welding because of the added potential for fire, burns, respiratory problems, and electrical shock. Ensure that trainees are briefed on shop safety procedures.

Additional Resources

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

Recommended Practices for Plasma Arc Cutting, Latest Edition. Miami, FL: The American Welding Society.

Teaching Time for this Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 7½ hours are suggested to cover *Plasma Arc 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; Plasma Arc Cutting Processes and Equipment	
A. Introduction	_____
B. Plasma Arc Cutting Process	_____
C. Plasma Arc Cutting Equipment	_____
D. Preparing the Work Area for PAC	_____
E. Setting Up PAC Equipment	_____
F. Laboratory	_____
Trainees practice setting up PAC equipment and setting the amperage and gas pressures or flow rates for the type and thickness of metal to be cut. This laboratory corresponds to Performance Tasks 1 and 2.	
Session II. Operation of Plasma Arc Cutting Equipment	
A. Operating PAC Equipment	_____
1. Square-Cutting Metal	_____
2. Bevel-Cutting Metal	_____
3. Piercing and Slot-Cutting Metal	_____
B. Laboratory	_____
Trainees practice operating PAC equipment. This laboratory corresponds to Performance Tasks 3 through 5.	
Session III. Equipment Storage and Maintenance; Laboratory; Repair; Review and Testing	
A. Proper Equipment Storage and Housekeeping	_____
B. Laboratory	_____
Trainees practice dismantling and storing the equipment. This laboratory corresponds to Performance Task 6.	
C. Repair of Plasma Arc Cutting Equipment	_____
D. Module Review	_____

E. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

F. Performance Testing

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

G. Performance Accreditation Tasks – Have trainees complete PAT 1 according to the acceptance criteria.

1. Have trainees perform PAT 1, Plasma Arc Cutting. This task corresponds to AWS EG2.0, Module 8 – Thermal Cutting Processes, Unit 3 – Manual Plasma Arc Cutting (PAC), Key Indicators: 3, 4, and 5.

Module Overview

This module describes air carbon arc cutting (CAC-A) equipment, safe work area preparation, CAC-A methods for cutting and cleaning defective metals, CAC-A methods for gouging and preparing base metals, and proper storage and housekeeping of CAC-A equipment.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum* and *Welding Level One*, Modules 29101-09 through 29103-09.

Objectives

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

1. Identify and explain the air carbon arc cutting (CAC-A) process and equipment.
2. Select and install CAC-A electrodes.
3. Prepare the work area and CAC-A equipment for safe operation.
4. Use CAC-A equipment for washing and gouging activities.
5. Perform storage and housekeeping activities for CAC-A equipment.
6. Make minor repairs to CAC-A equipment.

Performance Tasks

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

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

Materials and Equipment List

Markers/chalk	Tape measure
Pencils and scratch paper	Pliers
Whiteboard/chalkboard	Wire brush
Welding 1 PowerPoint® Presentation Slides (ISBN 0-13-609092-3)	Chipping hammer
Multimedia projector and screen	CAC-A unit with cutting torch and appropriate gas sources
Desktop or laptop computer	Scrap steel shapes containing bolts, rivets, protruding welds, eyes, clips, and other protrusions to be washed
Pencils and scratch paper	DC welding machine, minimum 200 amps for light duty, or 600 amps for medium duty
Appropriate personal protective equipment	Air carbon arc torch and cable
Leather protective gear (jacket or sleeves)	Selection of carbon electrodes up to $\frac{3}{8}$ "
Various welding gloves	Compressed air source, minimum of 16 cfm at 80 psig for light and medium duty, or minimum of 50 cfm at 100 psig for heavy duty
Samples of protective welding footwear	Module Examinations*
Welding shield or helmet with appropriate lenses	Performance Profile Sheets*
Earplugs	
Safety glasses with approved lenses	
Full face shields	
Respirator	
Soapstone	

*Located in the Test Booklet

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize the special safety precautions associated with welding because of the added potential for fire, burns, respiratory problems, and electrical shock. Ensure that trainees are briefed on shop safety procedures.

Additional Resources

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

ANSI C5.3, Recommended Practices for Air Carbon Arc Gouging and Cutting, Latest Edition. Miami, FL: American Welding Society.

Teaching Time for this Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 12½ hours are suggested to cover *Air Carbon Arc Cutting and Gouging*. You will need to adjust the time required for testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

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

Session IV. Washing and Gouging with CAC-A Equipment

A. CAC-A Planning _____

B. CAC-A Washing _____

C. Laboratory _____

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

D. CAC-A Gouging _____

E. Laboratory _____

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

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

A. Proper Storage of CAC-A Equipment _____

B. Repair of CAC-A Equipment _____

C. Laboratory _____

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

D. Module Review _____

E. Module Examination _____

1. Trainees must score 70% or higher to receive recognition from NCCER. _____

2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor. _____

F. Performance Testing _____

1. Trainees must complete each task to the satisfaction of the instructor to receive recognition from the NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the performance testing requirements. _____

2. Record the testing results on Craft Training Report Form 200 and submit the results to the Training Program Sponsor. _____

G. Performance Accreditation Tasks – Have trainees complete PATs 1 through 3 according to the acceptance criteria. _____

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

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 the following: *Core Curriculum* and *Welding Level One*, Modules 29101-09 through 29104-09.

Objectives

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

1. Clean base metal for welding or cutting.
2. Identify and explain joint design.
3. Explain joint design considerations.
4. Mechanically bevel the edge of a mild steel plate.
5. Thermally bevel the end of a mild steel plate.
6. Select the proper joint design based on a welding procedure specification (WPS) or instructor direction.

Performance Tasks

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

1. Mechanically bevel the edge of a mild steel plate $\frac{1}{4}$ " to $\frac{3}{4}$ " thick at $22\frac{1}{2}$ degrees (or 30 degrees, depending on the equipment available).
2. Thermally prepare a bevel.

Materials and Equipment List

Markers/chalk	Examples of fillet welds
Pencils and scratch paper	Sections of bar stock to illustrate various joints
Whiteboard/chalkboard	An oxyfuel or plasma arcing system or pictures showing how these systems can be used for joint preparation
Welding 1 PowerPoint® Presentation Slides (ISBN 0-13-609092-3)	Properly beveled coupons
Multimedia projector and screen	Chipping hammer
Desktop or laptop computer	Soapstone
Appropriate personal protective equipment	Tape measure
Full face shields	Pliers
Examples (photos or actual objects) of metals that have and have not been prepared for welding	Files
Examples of surface corrosion on different metals	Framing square
Examples of defects caused by surface contamination	Combination square with protractor head
MSDSs for metal cleaning chemicals	Hand scrapers and wire brushes
Examples of welding drawings and welding procedure specifications	Power grinder with grinding and wire brush attachments
Examples of surfacing welds	Mechanical beveling equipment for plate
Photos of surfacing welds before and after being ground down and cleaned	Thermal beveling equipment for plate
Examples of plug and slot welds	Module Examinations*
	Performance Profile Sheets*

*Located in the Test Booklet

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 12½ 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	_____
Session II. Joint Design I	
A. Load Considerations	_____
B. Types of Joints	_____
C. Types of Welds	_____
Session III. Joint Design II	
A. Types of Welds (continued)	_____
B. Welding Position	_____
C. Codes and Welding Procedure Specifications	_____
D. Welding Joint Preparation	_____
1. Identify Joint Specification	_____
2. Mechanical Joint Preparation	_____

Session IV. Laboratory; Welding Joint Preparation (Continued)

A. Laboratory

Trainees practice beveling steel plate by mechanical means. This laboratory corresponds to Performance Task 1.

B. Thermal Joint Preparation

Session V. Laboratory; Review and Testing

A. Laboratory

Trainees practice beveling steel plate by thermal means. This laboratory corresponds to Performance Task 2.

B. Module Review

C. Module Examination

1. Trainees must score 70% or higher to receive recognition from the NCCER.
2. Record the testing results on Craft 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 the NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the performance testing requirements.
2. Record the testing results on Craft Training Report Form 200 and submit the results to the Training Program Sponsor.

E. Performance Accreditation Tasks - Have trainees complete PATs 1 and 2 according to the acceptance criteria.

1. Have trainees perform PAT 1, Prepare Plate Joints Mechanically. This task has no AWS EG2.0 reference.
2. Have trainees perform PAT 2, Prepare Plate Joints Thermally. This task corresponds to AWS EG2.0, Module 8 – Thermal Cutting Processes, Unit 2 – Manual OFC Principles, Key Indicators: 4, 5, and 6.

Module Overview

This module teaches the importance of quality workmanship and covers how to find, identify, and avoid weld imperfections while adhering to necessary codes and specifications.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum* and *Welding Level One*, Modules 29101-09 through 29105-09.

Objectives

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

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.
7. Perform a visual inspection of fillet welds.

Performance Tasks

There are no performance tasks for this module.

Materials and Equipment List

Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

Welding 1 PowerPoint® Presentation Slides
(ISBN 0-13-609092-3)

Multimedia projector and screen

Desktop or laptop computer

Pencils and scratch paper

Appropriate personal protective equipment

Welding samples showing:

- Porosity
- Inclusions
- Cracks
- Weld metal cracks
- Base metal cracks
- Incomplete joint penetration
- Incomplete fusion
- Undercut

- Arc strikes
- Spatter
- Unacceptable weld profiles

Undercut gauge

Butt weld reinforcement gauge

Fillet weld blade gauge set

Welding coupon examples

Samples of ASME, AWS, API, and ANSI welding codes

Photos of damage to equipment and structures caused by failed welds

Examples of Welding Procedure Specifications and Procedure Qualification Records

Liquid penetrant test kit

Radiograph examples

Tested specimens of good and failed welds

Module Examinations*

*Located in the Test Booklet

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment. Review general safety guidelines associated with welding and refer to the MSDS for liquid penetrant solvent.

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.

AWS B1.10: Guide for the Nondestructive Inspection of Welds, 1999. Miami, FL: The American Welding Society.

AWS B1.11: Guide for the Visual Inspection of Welds, 2000. Miami, FL: The American Welding Society.

OSHA Standard 1926.351, Arc Welding and Cutting.

Welding Handbook, Volume 1 (2001) and Volume 2 (2004). Miami, FL: The American Welding Society.

AWS D3.5-93R: Guide for Steel Hull Welding, 1993. Miami, FL: The American Welding Society.

AWS D3.6M: Specification for Underwater Welding, 1999. Miami, FL: The American Welding Society.

AWS D3.7: Guide for Aluminum Hull Welding, 2004. Miami, FL: The American Welding Society.

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

Teaching Time for this Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Weld Quality*. 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; Codes; Weld Discontinuities	
A. Introduction	_____
B. Codes Governing Welding	_____
1. American Society of Mechanical Engineers	_____
2. American Welding Society	_____
3. American Petroleum Institute	_____
4. American National Standards Institute	_____
5. Marine Codes	_____
C. Basic Elements of Welding Codes	_____
1. Welding Procedure Qualification	_____
2. Welder Performance Qualification	_____
3. Welder Operator Qualification	_____
D. Weld Discontinuities and Their Causes	_____
1. Porosity	_____
2. Inclusions	_____
3. Cracks	_____
4. Incomplete Joint Penetration	_____
5. Incomplete Fusion	_____
6. Undercut	_____
7. Arc Strikes	_____
8. Spatter	_____
9. Acceptable and Unacceptable Weld Profiles	_____

Session II. Nondestructive Examination (NDE) Practices

- A. Visual Inspection
- B. Liquid Penetrant Inspection
- C. Magnetic Particle Inspection
- D. Radiographic Inspection
- E. Ultrasonic Inspection
- F. Electromagnetic (Eddy Current) Inspection
- G. Leak Testing

Session III. Destructive Testing; Welder Performance Qualification Tests

- A. Destructive Testing
- B. Welder Performance Qualification Tests
 - 1. Welding Positions Qualification
 - 2. AWS Structural Steel Code
 - 3. ASME Code
 - 4. Welder Qualification Tests

Session IV. Quality Workmanship; Review and Testing

- A. Quality Workmanship
 - 1. Typical Site Organization
 - 2. Chain of Command
- B. Module Review
- C. Module Examination
 - 1. Trainees must score 70% or higher to receive recognition from the NCCER.
 - 2. Record the testing results on Craft Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module covers shielded metal arc welding (SMAW) safety, types of SMAW equipment, and how to set up SMAW equipment for use.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum* and *Welding Level One*, Modules 29101-09 through 29106-09.

Objectives

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

1. Identify and explain shielded metal arc welding (SMAW) safety.
2. Explain welding electrical current.
3. Identify welding power supplies and their characteristics.
4. Explain how to set up welding power supplies.
5. Set up a machine for welding.
6. Identify tools used for weld cleaning.

Performance Tasks

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

1. Set up a SMAW machine for welding.

Materials and Equipment List

Markers/chalk	Chipping hammers
Pencils and scratch paper	Wire brushes
Whiteboard/chalkboard	Files
Welding 1 PowerPoint® Presentation Slides (ISBN 0-13-609092-3)	Pneumatic weld flux chipper
Multimedia projector and screen	Pneumatic needle scaler
Desktop or laptop computer	Transformer welding machine
Appropriate personal protective equipment	Transformer-rectifier welding machine
Welding cables	Motor generator welding machine
Lugs and quick disconnects	Engine-driven generator welding machine and alternator
Workpiece clamps	(If any of these welding machines are unavailable, provide photos instead)
Electrode holders	Module Examinations*
Electrical plugs used with welding machines and matching electrical outlets	Performance Profile Sheets*

*Located in the Test Booklet

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment. Review general safety guidelines associated with arc welding and engine-driven machinery, including electrical safety and procedures to prevent carbon monoxide poisoning. Explain that welding machines are heavy and can cause injury if they fall on people. Proper rigging devices and procedures must be used when lifting and moving welding machines. Emphasize that welding sparks can cause batteries to explode, showering the area with acid.

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.

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

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

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

Teaching Time for this Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 5 hours are suggested to cover *SMAW – Equipment and Setup*. 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. Shielded Metal Arc Welding	
A. Introduction	_____
B. SMAW Safety	_____
1. Moving Welding Equipment	_____
2. Electrical Hazards	_____
3. Lifting Hazards	_____
4. Working at Heights	_____
5. Welding Hazards	_____
C. Welding Current	_____
1. Types of Welding Current	_____
2. Polarity	_____
3. Characteristics of Welding Current	_____
D. SMAW Machines	_____
1. SMAW Machine Classifications	_____
2. SMAW Machine Types	_____
3. SMAW Machine Ratings	_____
4. Welding Cable	_____
5. SMAW Cable Connectors	_____
E. SMAW Equipment Setup	_____
1. Selecting the Proper SMAW Equipment	_____
2. Welding Machine Location	_____
3. Moving a Welding Machine	_____
4. Stringing Welding Cable	_____
5. Locating the Workpiece Clamp	_____
F. Starting SMAW Welding Machines	_____
1. Energizing Electrically Powered Welding Machines	_____
2. Starting Engine-Driven Welding Machines	_____
G. Tools for Cleaning Welds	_____
1. Hand Tools	_____
2. Pneumatic Cleaning and Slag Removal Tools	_____

Session II. Laboratory; Review and Testing

A. Laboratory

Trainees practice setting up a machine for welding.

B. Module Review

C. Module Examination

1. Trainees must score 70% or higher to receive recognition from the NCCER.
2. Record the testing results on Craft 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 the NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the performance testing requirements.
2. Record the testing results on Craft Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module discusses the classification, selection, storage, and control of electrodes that are used for shielded metal arc welding.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum* and *Welding Level One*, Modules 29101-09 through 29107-09.

Objectives

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

1. Identify factors that affect electrode selection.
2. Explain the American Welding Society (AWS) and the American Society of Mechanical Engineers (ASME) filler metal classification system.
3. Identify different types of filler metals.
4. Explain the storage and control of filler metals.
5. Explain filler metal traceability requirements and how to use applicable code requirements.
6. Identify and select the proper electrode for an identified welding task.

Performance Tasks

There are no performance tasks for this module.

Materials and Equipment List

Markers/chalk	Desktop or laptop computer
Pencils and scratch paper	Appropriate personal protective equipment
Whiteboard/chalkboard	Electrodes of various types
Welding 1 PowerPoint® Presentation Slides (ISBN 0-13-609092-3)	Sample MSDS for an electrode
Multimedia projector and screen	Sample MSDS for a surface coating
	Module Examinations*

*Located in the Test Booklet

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment. Review general safety guidelines associated with welding and refer to the MSDS for each electrode type. Point out that many surface coatings produce toxic fumes when heated.

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.

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

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

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

Teaching Time for this Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 2½ hours are suggested to cover *SMAW – Electrodes*. 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; SMAW Electrodes; Review and Examination	
A. Introduction	_____
B. Shielded Metal Arc Welding Electrodes	_____
C. AWS Filler Metal Specification System	_____
1. Classification System	_____
2. Manufacturers' Classification	_____
3. Electrode Sizes	_____
D. Selecting Electrodes	_____
1. Electrode Groups	_____
2. Electrode Selection Considerations	_____
E. Filler Metal Storage and Control	_____
1. Code Requirements	_____
2. Receiving Filler Metal	_____
3. Storing Filler Metal	_____
4. Storage Ovens	_____
F. Filler Metal Traceability Requirements	_____
G. Module Review	_____
H. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from the NCCER.	
2. Record the testing results on Craft Training Report Form 200 and submit the results to the Training Program Sponsor.	

Module Overview

This module explains how to strike an arc and how to make stringer, weave, and overlapping beads with E6010 and E7018 electrodes. It also covers making fillet welds in the 2F, 3F, and 4F positions with E6010 and E7018 electrodes.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum* and *Welding Level One*, Modules 29101-09 through 29108-09.

Objectives

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

1. Set up shielded metal arc welding (SMAW) equipment.
2. Describe methods of striking an arc.
3. Properly strike and extinguish an arc.
4. Describe causes of arc blow and wander.
5. Make stringer, weave, and overlapping beads.
6. Make fillet welds in the following positions:
 - Horizontal (2F)
 - Vertical (3F)
 - Overhead (4F)

Performance Tasks

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

1. Set up welding equipment.
2. Strike an arc.
3. Make stringer, weave, and overlapping beads using E6010 and E7018 electrodes.
4. Make corner welds on an angle iron section end welded to a plate coupon.
5. Make fillet welds using E6010 and E7018 electrodes in the specified position:
 - Horizontal (2F)
 - Vertical (3F)
 - Overhead (4F)

Materials and Equipment List

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Welding 1 PowerPoint® Presentation Slides
(ISBN 0-13-609092-3)
Multimedia projector and screen
Desktop or laptop computer
Appropriate personal protective equipment
Sample electrodes
Rod holders
Carbon steel for practice coupons, ¼" thick
minimum
Angle iron sections, ⅜" thick
DC or AC welding machine
Welding bench with arm for position work

Oxyfuel cutting equipment
Welding shield or helmet
Grinders
Framing square
Soapstone
Tape measure
Pliers
Wire brush
Workpiece clamps
Chipping hammer
Electrode holder
Electrodes, E6010 and E7018 (or E6011 and E6013
for AC)
Friction lighter
Module Examinations*
Performance Profile Sheets*

*Located in the Test Booklet

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment. Review general safety guidelines associated with arc welding, including electrical safety. Emphasize the importance of proper housekeeping. Point out that face shields must be worn to prevent injury from hot slag.

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.

Stick Electrode Welding Guide, 2004. 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 120 hours are suggested to cover *Shielded Metal Arc Welding – Beads and Fillet Welds*. 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. The laboratory portion should take approximately 107½ hours, or 43 sessions.

Topic	Planned Time
Session I. Shielded Metal Arc Welding – Beads and Fillet Welds	
A. Introduction	_____
B. Safety Summary	_____
1. Protective Clothing and Equipment	_____
2. Fire/Explosion Prevention	_____
3. Work Area Ventilation	_____
C. Arc Welding Equipment Setup	_____
1. Preparing the Welding Area	_____
2. Preparing the Weld Coupons	_____
3. Electrodes	_____
4. Preparing the Welding Machine	_____
D. Striking an Arc	_____
1. Scratching Method	_____
2. Tapping Method	_____
3. Practicing Striking and Extinguishing an Arc	_____
E. Arc Blow	_____
Session II. Laboratory Practice and Performance Testing	
A. Laboratory	_____
Trainees practice setting up welding equipment, striking an arc, and extinguishing an arc. This laboratory corresponds to Performance Tasks 1 and 2.	

Session III. Stringer, Weave, and Overlapping Beads

A. Stringer and Weave Beads

1. Practicing Stringer Beads with E6010
2. Practicing Stringer Beads with E7018
3. Restarting a Weld
4. Terminating a Weld
5. Practicing Weave Beads with E6010
6. Practicing Weave Beads with E7018

B. Overlapping Beads

1. Practicing Overlapping Beads with E6010
2. Practicing Overlapping Beads with E7018

C. Make Corner Welds

Session IV. Fillet Welds

A. Fillet Weld Positions

- B. Practicing Horizontal Fillet Welds with E6010 (2F position)
- C. Practicing Horizontal Fillet Welds with E7018 (2F position)
- D. Practicing Vertical Fillet Welds with E6010 (3F position)
- E. Practicing Vertical Fillet Welds with E7018 (3F position)
- F. Practicing Overhead Fillet Welds with E6010 (4F position)
- G. Practicing Overhead Fillet Welds with E7018 (4F position)

Sessions V – XLVII. Laboratory and Performance Testing

A. Laboratory (43 sessions). This laboratory corresponds to Performance Tasks 3 and 4.

1. Trainees prepare practice welding coupons
2. Trainees practice the following using E6010 electrodes:
 - Make stringer, weave, and overlapping beads
 - Make fillet welds in the 2F, 3F, and 4F positions
3. Trainees practice the following using E7018 electrodes:
 - Make stringer, weave, and overlapping beads
 - Make fillet welds in the 2F, 3F, and 4F positions

Session XLVIII. Review and Testing; Performance Accreditation Tasks

A. Module Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from the NCCER.
2. Record the testing results on Craft 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 the NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the performance testing requirements.

D. Performance Accreditation Tasks – Have trainees complete PAT 1 through PAT 8 according to the acceptance criteria.

1. Have trainees perform PAT 1, Build a Pad with E6010 Electrodes in the Flat Position. This task corresponds to *AWS EG2.0*, Module 4 – Shielded Metal Arc Welding, Key Indicators: 3 and 4.
2. Have trainees perform PAT 2, Build a Pad with E7018 Electrodes in the Flat Position. This task corresponds to *AWS EG2.0*, Module 4 – Shielded Metal Arc Welding, Key Indicators: 3 and 4.
3. Have trainees perform PATs 3, 5, and 7, Make Fillet Welds with E6010 Electrodes in 2F, 3F, and 4F Positions. This task corresponds to *AWS EG2.0*, Module 4 – Shielded Metal Arc Welding, Key Indicators: 3, 4, and 5.
4. Have trainees perform PATs 4, 6, and 8, Make Fillet Welds with E7018 Electrodes in 2F, 3F, and 4F Positions. This task corresponds to *AWS EG2.0*, Module 4 – Shielded Metal Arc Welding, Key Indicators: 3, 4, and 5.

Module Overview

This module covers job code specifications, using gauges to check joint fit-up, fitting up joints using pipe and plate fit-up tools, controlling distortion, and checking for misalignment and poor fit-up.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum* and *Welding Level One*, Modules 29101-09 through 29109-09.

Objectives

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

1. Identify and explain job code specifications.
2. Use fit-up gauges and measuring devices to check joint fit-up.
3. Identify and explain distortion and how it is controlled.
4. Fit up joints using plate and pipe fit-up tools.
5. Check for joint misalignment and poor fit-up before and after welding.

Performance Tasks

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

1. Fit up joints using plate and pipe fit-up tools.
2. Check the joint for proper fit-up and alignment using gauges and measuring devices.

Materials and Equipment List

Markers/chalk	Hydraulic jacks, chain hoists, come-alongs
Pencils and scratch paper	Strongbacks, clips, yokes, wedges
Whiteboard/chalkboard	Plate alignment tools
Welding 1 PowerPoint® Presentation Slides (ISBN 0-13-609092-3)	Pipe jacks and rollers
Multimedia projector and screen	Chain clamps, cage clamps, rim clamps
Desktop or laptop computer	Small-diameter pipe clamping devices
Appropriate personal protective equipment	Pipe pullers
Straightedges	Flange alignment tools
Squares	Carbon steel plate and pipe of various sizes
Levels	Module Examinations*
Hi-Lo gauges	Performance Profile Sheets*

* Located in the Test Booklet

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment. Review general safety guidelines associated with welding, including electrical safety. Emphasize that jack stands and roller assemblies should not be field-fabricated.

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.

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

Welding Handbook, 2001. Miami, FL: The American Welding Society.

The Dearman System Booklet, 2008. Tulsa, OK: The Mathey Dearman Company.

Teaching Time for this Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 5 hours are suggested to cover *Joint Fit-Up and Alignment*. 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; Joint Fit-Up and Alignment	
A. Introduction	_____
B. Job Code Specifications	_____
1. Governing Codes and Standards	_____
2. Code Changes	_____
3. Welding Procedure Specifications	_____
C. Fit-Up Gauges and Measuring Devices	_____
1. Straightedges	_____
2. Squares	_____
3. Levels	_____
4. Hi-Lo Gauges	_____
D. Fit-Up Tools	_____
1. Positioning Parts of a Weldment	_____
2. Plate Fit-Up Tools	_____
3. Pipe Fit-Up Tools	_____
E. Weldment Distortion	_____
1. Causes of Distortion	_____
2. Correlation of Metal Properties and Distortion	_____
3. Controlling Distortion	_____
F. Checking Joint Misalignment and Poor Fit-Up	_____

Module Overview

This module explains how to make groove welds with backing in the 1G, 2G, 3G, and 4G positions using E7018 electrodes.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum* and *Welding Level One*, Modules 29101-09 through 29110-09.

Objectives

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

1. Identify and explain groove welds.
2. Identify and explain groove welds with backing.
3. Set up shielded metal arc welding (SMAW) equipment for making V-groove welds.
4. Perform SMAW for V-groove welds with backing in the following positions:
 - Flat (1G)
 - Horizontal (2G)
 - Vertical (3G)
 - Overhead (4G)

Performance Tasks

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

1. Set up arc welding equipment for making groove welds.
2. Make flat welds with backing on V-groove joints using E7018 electrodes.
3. Make horizontal welds with backing on V-groove joints using E7018 electrodes.
4. Make vertical welds with backing on V-groove joints using E7018 electrodes.
5. Make overhead welds with backing on V-groove joints using E7018 electrodes.

Materials and Equipment List

Markers/chalk	Welding shield or helmet
Pencils and scratch paper	Grinders
Whiteboard/chalkboard	Framing square
Welding 1 PowerPoint® Presentation Slides (ISBN 0-13-609092-3)	Soapstone
Multimedia projector and screen	Tape measure
Desktop or laptop computer	Pliers
Appropriate personal protective equipment	Wire brush
Sample electrodes	Workpiece clamps
Carbon steel for practice coupons, ¼" thick minimum	Chipping hammer
DC or AC welding machine	Electrode holder
Welding bench with arm for position work	Electrodes, 5/32" and 3/16" E7018 (or E6013 for AC)
Oxyfuel cutting equipment	Friction lighter
	Module Examinations*
	Performance Profile Sheets*

*Located in the Test Booklet

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment. Review general safety guidelines associated with arc welding, including electrical safety. Emphasize the importance of proper housekeeping. Point out that face shields must be worn to prevent injury from hot slag. Warn the trainees of the dangers of hot weld coupons.

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 Technology, 2004. J. W. Giachino, W. R. Weeks, G. S. Johnson. Homewood, IL: American Technical Publishers, Inc.
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 30 hours are suggested to cover *SMAW – Groove Welds with Backing*. 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. The laboratory portion should take approximately 22.5 hours, or 9 sessions.

Topic	Planned Time
Session I. Groove Welds and Welding Equipment Setup	
A. Introduction	_____
B. Groove Welds	_____
1. Typical Groove Weld Styles	_____
2. Single and Double Groove Welds	_____
3. Groove Weld Terms	_____
4. Combination Groove and Fillet Welds	_____
5. Backings	_____
C. Welding Equipment Setup	_____
1. Safety Practices	_____
2. Preparing the Welding Area	_____
3. Preparing the Weld Coupons	_____
4. Electrodes	_____
5. Preparing the Welding Machine	_____
D. Laboratory	_____
Trainees practice setting up welding equipment for making groove welds. This laboratory corresponds to Performance Task 1.	
Session II. V-Groove Welds with Backing and SMAW of Groove Welds with Backing	
A. V-Groove Welds with Backing	_____
1. Groove Weld Positions	_____
2. Acceptable and Unacceptable Groove Weld Profiles	_____
B. SMAW of V-Groove Welds with Backing	_____
1. Practicing Flat V-Groove Welds with Backing (1G Position)	_____
2. Horizontal Welds (2G Position)	_____
3. Vertical Welds (3G Position)	_____
4. Overhead Welds (4G Position)	_____

Sessions III – XI. Laboratory

A. Laboratory (9 sessions)

1. Trainees prepare practice welding coupons.
2. Trainees practice making V-groove welds with backing in the 1G, 2G, 3G, and 4G positions using E7018 electrodes. This laboratory corresponds to Performance Tasks 2 through 5.

Session XII. Review and Testing; Performance Accreditation Tasks

A. Module Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from the NCCER.
2. Record the testing results on Craft Training Report 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.
2. Record the testing results on Craft Training Report 200 and submit the results to the Training Program Sponsor.

D. Performance Accreditation Tasks – Have trainees complete PAT 1 through PAT 4, according to the acceptance criteria.

1. Have trainees perform PAT 1, Make V-Groove Welds with Backing in the Flat (1G) Position. This task corresponds to *AWS EG2.0*, Module 4 – Shielded Metal Arc Welding, Key Indicators: 3, 4, and 6
2. Have trainees perform PAT 2, Make V-Groove Welds with Backing in the Horizontal (2G) Position. This task corresponds to *AWS EG2.0*, Module 4 – Shielded Metal Arc Welding, Key Indicators: 3, 4, and 6
3. Have trainees perform PAT 3, Make V-Groove Welds with Backing in the Vertical (3G) Position. This task corresponds to *AWS EG2.0*, Module 4 – Shielded Metal Arc Welding, Key Indicators: 3, 4, and 6
4. Have trainees perform PAT 3, Make V-Groove Welds with Backing in the Overhead (4G) Position. This task corresponds to *AWS EG2.0*, Module 4 – Shielded Metal Arc Welding, Key Indicators: 3, 4, and 6

Module Overview

This module explains how to prepare arc welding equipment and make welds on pads and open-root V-groove joints in the 1G, 2G, 3G, and 4G positions using E6010 and E7018 electrodes.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum* and *Welding Level One*, Modules 29101-09 through 29111-09.

Objectives

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

1. Prepare shielded metal arc welding (SMAW) equipment for open-root V-groove welds.
2. Perform open-root V-groove welds in the following positions:
 - Flat (1G) position
 - Horizontal (2G) position
 - Vertical (3G) position
 - Overhead (4G) position

Performance Tasks

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

1. Prepare arc welding equipment for open V-groove welds.
2. Make open V-groove welds with E6010 and E7018 electrodes in the following positions:
 - Flat (1G) position
 - Horizontal (2G) position
 - Vertical (3G) position
 - Overhead (4G) position

Materials and Equipment List

Markers/chalk	Oxyfuel cutting equipment
Pencils and scratch paper	Welding shield or helmet
Whiteboard/chalkboard	Grinders
Welding 1 PowerPoint® Presentation Slides (ISBN 0-13-609092-3)	Framing squares
Multimedia projector and screen	Soapstone
Desktop or laptop computer	Pliers
Markers/chalk	Friction lighters
Pencils and scratch paper	Wire brush
Appropriate personal protective equipment	Chipping hammer
Sample electrodes	Workpiece clamps
Carbon steel for practice coupons, ¼" thick minimum	Electrode holder
DC (or AC) welding machine	Electrodes, E6010 and E7018 (or E6011 and E6013 for AC)
Welding bench with arm for position work	Module Examinations*
	Performance Profile Sheets*

*Located in the Test Booklet

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 used in preparing the coupons. 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 work is suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

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 80 hours are suggested to cover *SMAW – Open V-Groove Welds*. 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. The laboratory portion of this course should take approximately 62.5 hours, or 25 sessions.

Topic	Planned Time
Session I. Introduction; Welding Equipment Setup	
A. Introduction	_____
B. Welding Equipment Setup	_____
1. Safety Practices	_____
2. Preparing the Welding Area	_____
3. Preparing the Weld Coupons	_____
4. Electrodes	_____
5. Preparing the Welding Machine	_____
C. Laboratory	_____
Trainees prepare the welding area and coupons, and practice setting up arc welding equipment for open V-groove welds. This laboratory corresponds to Performance Task 1.	
Session II. Open-Root V-Groove Welds; SMAW of Open-Root V-Groove Welds	
A. Open-Root V-Groove Welds	_____
1. Root Pass	_____
2. Groove Weld Positions	_____
3. Acceptable and Unacceptable Groove Weld Profiles	_____
B. SMAW of Open-Root V-Groove Welds	_____
1. Practicing Flat Open-Root V-Groove Welds (1G Position)	_____
2. Horizontal Welds (2G Position)	_____
3. Vertical Welds (3G Position)	_____
4. Overhead Welds (4G Position)	_____

Sessions III. XXXI. Laboratory

A. Laboratory (25 sessions). This laboratory corresponds to Performance Task 2. _____

Trainees practice making open V-groove welds with E6010 and E7018 electrodes in the following positions:

- Flat (1G)
- Horizontal (2G)
- Vertical (3G)
- Overhead (4G)

Session XXXII. Review and Testing; Performance Accreditation Tasks

A. Module Review _____

B. Module Examination _____

1. Trainees must score 70% or higher to receive recognition from the NCCER.
2. Record the testing results on Craft 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.
2. Record the testing results on Craft Training Report Form 200 and submit the results to the Training Program Sponsor.

D. Performance Accreditation Tasks – Have trainees complete PAT 1 through PAT 4, according to the acceptance criteria. _____

1. Have trainees perform PAT 1, Make Open V-Groove Welds with E6010 and E7018 electrodes in the Flat (1G) Position. This task corresponds to *AWS EG2.0*, Module 4 – Shielded Metal Arc Welding, Key Indicators: 3, 4, and 6 _____
2. Have trainees perform PAT 2, Make Open V-Groove Welds with E6010 and E7018 electrodes in the Horizontal (2G) Position. This task corresponds to *AWS EG2.0*, Module 4 – Shielded Metal Arc Welding, Key Indicators: 3, 4, and 6 _____
3. Have trainees perform PAT 3, Make Open V-Groove Welds with E6010 and E7018 electrodes in the Vertical (3G) Position. This task corresponds to *AWS EG2.0*, Module 4 – Shielded Metal Arc Welding, Key Indicators: 3, 4, and 6 _____
4. Have trainees perform PAT 3, Make Open V-Groove Welds with E6010 and E7018 electrodes in the Overhead (4G) Position. This task corresponds to *AWS EG2.0*, Module 4 – Shielded Metal Arc Welding, Key Indicators: 3, 4, and 6 _____