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.


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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session I. Introduction; Welding Safety Practices</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Welding Safety Practices</td>
<td></td>
</tr>
<tr>
<td>C. Appropriate Personal Protective Equipment</td>
<td></td>
</tr>
<tr>
<td>D. Fumes and Gases</td>
<td></td>
</tr>
<tr>
<td>E. Confined Space Permits</td>
<td></td>
</tr>
<tr>
<td>F. Area Safety</td>
<td></td>
</tr>
<tr>
<td>G. Hot Work Permits and Fire Watches</td>
<td></td>
</tr>
<tr>
<td>H. Oxyfuel Gas Welding and Cutting Safety</td>
<td></td>
</tr>
<tr>
<td>I. Cutting Containers</td>
<td></td>
</tr>
<tr>
<td>J. Cylinder Storage and Handling</td>
<td></td>
</tr>
<tr>
<td>K. Power Tool Safety</td>
<td></td>
</tr>
<tr>
<td>L. Electrical Safety</td>
<td></td>
</tr>
<tr>
<td>M. Material Safety Data Sheets</td>
<td></td>
</tr>
<tr>
<td>N. Material Handling</td>
<td></td>
</tr>
<tr>
<td>O. Safety Planning and Emergency Action Plans</td>
<td></td>
</tr>
<tr>
<td>P. Module Review</td>
<td></td>
</tr>
<tr>
<td>Q. Module Examination</td>
<td></td>
</tr>
<tr>
<td>1. Trainees must score 70% or higher to receive recognition from NCCER.</td>
<td></td>
</tr>
<tr>
<td>2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.</td>
<td></td>
</tr>
</tbody>
</table>
Oxyfuel Cutting
Annotated Instructor’s Guide

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.
7. Perform oxyfuel cutting:
   a. Straight line and square shapes
   b. Piercing and slot cutting
   c. Bevels
   d. Washing
   e. 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:
   a. Straight line
   b. Square shape
   c. Piercing
   d. Bevel
   e. Slot
7. Perform washing.
8. Perform gouging.

Materials and Equipment List
Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
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)
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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session I. Introduction to Oxyfuel Safety; Oxyfuel Cutting Equipment, Part One</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Oxyfuel Safety Summary</td>
<td></td>
</tr>
<tr>
<td>1. Protective Clothing and Equipment</td>
<td></td>
</tr>
<tr>
<td>2. Fire/Explosion Prevention</td>
<td></td>
</tr>
<tr>
<td>3. Work Area Ventilation</td>
<td></td>
</tr>
<tr>
<td>C. Oxyfuel Cutting Equipment</td>
<td></td>
</tr>
<tr>
<td>1. Oxygen</td>
<td></td>
</tr>
<tr>
<td>2. Acetylene</td>
<td></td>
</tr>
<tr>
<td>3. Liquefied Fuel Gases</td>
<td></td>
</tr>
<tr>
<td>4. Regulators</td>
<td></td>
</tr>
<tr>
<td>a. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Allow trainees to install and remove regulators from empty oxygen and gas cylinders.</td>
<td></td>
</tr>
<tr>
<td>5. Hoses</td>
<td></td>
</tr>
</tbody>
</table>
Session II. Oxyfuel Cutting Equipment, Part Two

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

Session III. Setting Up Oxyfuel Equipment; Controlling the Oxyfuel Torch Flame

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

B. Controlling the Oxyfuel Torch Flame
   1. Oxyfuel Flames
   2. Backfires and Flashbacks
   3. Igniting the Torch and Adjusting the Flame
   4. Shutting Off the Torch

Session IV. Shutting Down Oxyfuel Cutting Equipment; Disassembling Oxyfuel Equipment; Changing Cylinders

A. Shutting Down Oxyfuel Cutting Equipment
B. Disassembling Oxyfuel Equipment
C. Changing Cylinders
D. Laboratory
   Have trainees set up, ignite, adjust, shut down, and disassemble oxyfuel equipment, as well as change cylinders. This laboratory corresponds to Performance Tasks 1 through 5.

Session V. Performing Cutting Procedures, Part One

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. Washing
   8. Gouging
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.
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  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, ¾” 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  *Located in the Test Booklet
(welding labs may post them on bulletin boards)
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.


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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Plasma Arc Cutting Processes and Equipment</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Plasma Arc Cutting Process</td>
<td></td>
</tr>
<tr>
<td>C. Plasma Arc Cutting Equipment</td>
<td></td>
</tr>
<tr>
<td>D. Preparing the Work Area for PAC</td>
<td></td>
</tr>
<tr>
<td>E. Setting Up PAC Equipment</td>
<td></td>
</tr>
<tr>
<td>F. Laboratory</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Session II. Operation of Plasma Arc Cutting Equipment</strong></td>
<td></td>
</tr>
<tr>
<td>A. Operating PAC Equipment</td>
<td></td>
</tr>
<tr>
<td>1. Square-Cutting Metal</td>
<td></td>
</tr>
<tr>
<td>2. Bevel-Cutting Metal</td>
<td></td>
</tr>
<tr>
<td>3. Piercing and Slot-Cutting Metal</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td>Trainees practice operating PAC equipment. This laboratory corresponds to Performance Tasks 3 through 5.</td>
</tr>
<tr>
<td><strong>Session III. Equipment Storage and Maintenance; Laboratory; Repair; Review and Testing</strong></td>
<td></td>
</tr>
<tr>
<td>A. Proper Equipment Storage and Housekeeping</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td>Trainees practice dismantling and storing the equipment. This laboratory corresponds to Performance Task 6.</td>
</tr>
<tr>
<td>C. Repair of Plasma Arc Cutting Equipment</td>
<td></td>
</tr>
<tr>
<td>D. Module Review</td>
<td></td>
</tr>
</tbody>
</table>
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
- Pencils and scratch paper
- Whiteboard/chalkboard
- Multimedia projector and screen
- Desktop or laptop computer
- Pencils and scratch paper
- Appropriate personal protective equipment
- Leather protective gear (jacket or sleeves)
- Various welding gloves
- Samples of protective welding footwear
- Welding shield or helmet with appropriate lenses
- Earplugs
- Safety glasses with approved lenses
- Full face shields
- Respirator
- Soapstone
- Tape measure
- Pliers
- Wire brush
- Chipping hammer
- CAC-A unit with cutting torch and appropriate gas sources
- Scrap steel shapes containing bolts, rivets, protruding welds, eyes, clips, and other protrusions to be washed
- DC welding machine, minimum 200 amps for light duty, or 600 amps for medium duty
- Air carbon arc torch and cable
- Selection of carbon electrodes up to ½"
- 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
- 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 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.


## 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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Air Carbon Arc Cutting (CAC-A) Process and Equipment</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. CAC-A Process</td>
<td></td>
</tr>
<tr>
<td>C. CAC-A Equipment</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Selection and Installation of CAC-A Electrodes</strong></td>
<td></td>
</tr>
<tr>
<td>A. CAC-A Electrodes</td>
<td></td>
</tr>
<tr>
<td>B. Electrode Selection</td>
<td></td>
</tr>
<tr>
<td>C. Electrode Installation</td>
<td></td>
</tr>
<tr>
<td>D. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Trainees practice selecting and installing electrodes. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td><strong>Session III. Preparing Work Area and CAC-A Equipment</strong></td>
<td></td>
</tr>
<tr>
<td>A. Preparing Work Area for CAC-A</td>
<td></td>
</tr>
<tr>
<td>B. Setting Up CAC-A Equipment</td>
<td></td>
</tr>
<tr>
<td>C. Test Operating CAC-A Equipment</td>
<td></td>
</tr>
<tr>
<td>D. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Trainees practice setting up the work area and the CAC-A equipment. This laboratory corresponds to Performance Task 2.</td>
<td></td>
</tr>
</tbody>
</table>
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 ¼” to ¾” thick at 22½ degrees (or 30 degrees, depending on the equipment available).
2. Thermally prepare a bevel.

Materials and Equipment List

<table>
<thead>
<tr>
<th>Markers/chalk</th>
<th>Examples of fillet welds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pencils and scratch paper</td>
<td>Sections of bar stock to illustrate various joints</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td>An oxyfuel or plasma arcing system or pictures showing how these systems can be used for joint preparation</td>
</tr>
<tr>
<td>Multimedia projector and screen</td>
<td>Chipping hammer</td>
</tr>
<tr>
<td>Desktop or laptop computer</td>
<td>Soapstone</td>
</tr>
<tr>
<td>Appropriate personal protective equipment</td>
<td>Tape measure</td>
</tr>
<tr>
<td>Full face shields</td>
<td>Pliers</td>
</tr>
<tr>
<td>Examples (photos or actual objects) of metals that have and have not been prepared for welding</td>
<td>Files</td>
</tr>
<tr>
<td>Examples of surface corrosion on different metals</td>
<td>Framing square</td>
</tr>
<tr>
<td>Examples of defects caused by surface contamination</td>
<td>Combination square with protractor head</td>
</tr>
<tr>
<td>MSDSs for metal cleaning chemicals</td>
<td>Hand scrapers and wire brushes</td>
</tr>
<tr>
<td>Examples of welding drawings and welding procedure specifications</td>
<td>Power grinder with grinding and wire brush attachments</td>
</tr>
<tr>
<td>Examples of surfacing welds</td>
<td>Mechanical beveling equipment for plate</td>
</tr>
<tr>
<td>Photos of surfacing welds before and after being ground down and cleaned</td>
<td>Thermal beveling equipment for plate</td>
</tr>
<tr>
<td>Examples of plug and slot welds</td>
<td>Module Examinations*</td>
</tr>
<tr>
<td>*Located in the Test Booklet</td>
<td>Performance Profile Sheets*</td>
</tr>
</tbody>
</table>
Safety Considerations

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

Additional Resources

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

*OSHA Standard 1926.351, Arc Welding and Cutting*
www.lincolnelectric.com

Teaching Time for this Module

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Basic Welding Safety; Base Metal Cleaning</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Basic Welding Safety</td>
<td></td>
</tr>
<tr>
<td>1. Protective Clothing and Equipment for Preparing Metals</td>
<td></td>
</tr>
<tr>
<td>2. Fire/Explosion Prevention</td>
<td></td>
</tr>
<tr>
<td>3. Work Area Ventilation</td>
<td></td>
</tr>
<tr>
<td>C. Base Metal Cleaning</td>
<td></td>
</tr>
<tr>
<td>1. Surface Corrosion</td>
<td></td>
</tr>
<tr>
<td>2. Defects Caused by Surface Contamination</td>
<td></td>
</tr>
<tr>
<td>3. Mechanical Cleaning</td>
<td></td>
</tr>
<tr>
<td>4. Chemical Cleaning</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Joint Design I</strong></td>
<td></td>
</tr>
<tr>
<td>A. Load Considerations</td>
<td></td>
</tr>
<tr>
<td>B. Types of Joints</td>
<td></td>
</tr>
<tr>
<td>C. Types of Welds</td>
<td></td>
</tr>
<tr>
<td><strong>Session III. Joint Design II</strong></td>
<td></td>
</tr>
<tr>
<td>A. Types of Welds (continued)</td>
<td></td>
</tr>
<tr>
<td>B. Welding Position</td>
<td></td>
</tr>
<tr>
<td>C. Codes and Welding Procedure Specifications</td>
<td></td>
</tr>
<tr>
<td>D. Welding Joint Preparation</td>
<td></td>
</tr>
<tr>
<td>1. Identify Joint Specification</td>
<td></td>
</tr>
<tr>
<td>2. Mechanical Joint Preparation</td>
<td></td>
</tr>
</tbody>
</table>
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
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

*Located in the Test Booklet

• 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*
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.


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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Codes; Weld Discontinuities</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Codes Governing Welding</td>
<td></td>
</tr>
<tr>
<td>1. American Society of Mechanical Engineers</td>
<td></td>
</tr>
<tr>
<td>2. American Welding Society</td>
<td></td>
</tr>
<tr>
<td>3. American Petroleum Institute</td>
<td></td>
</tr>
<tr>
<td>4. American National Standards Institute</td>
<td></td>
</tr>
<tr>
<td>5. Marine Codes</td>
<td></td>
</tr>
<tr>
<td>C. Basic Elements of Welding Codes</td>
<td></td>
</tr>
<tr>
<td>1. Welding Procedure Qualification</td>
<td></td>
</tr>
<tr>
<td>2. Welder Performance Qualification</td>
<td></td>
</tr>
<tr>
<td>3. Welder Operator Qualification</td>
<td></td>
</tr>
<tr>
<td>D. Weld Discontinuities and Their Causes</td>
<td></td>
</tr>
<tr>
<td>1. Porosity</td>
<td></td>
</tr>
<tr>
<td>2. Inclusions</td>
<td></td>
</tr>
<tr>
<td>3. Cracks</td>
<td></td>
</tr>
<tr>
<td>4. Incomplete Joint Penetration</td>
<td></td>
</tr>
<tr>
<td>5. Incomplete Fusion</td>
<td></td>
</tr>
<tr>
<td>6. Undercut</td>
<td></td>
</tr>
<tr>
<td>7. Arc Strikes</td>
<td></td>
</tr>
<tr>
<td>8. Spatter</td>
<td></td>
</tr>
<tr>
<td>9. Acceptable and Unacceptable Weld Profiles</td>
<td></td>
</tr>
</tbody>
</table>
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
- Pencils and scratch paper
- Whiteboard/chalkboard
- Multimedia projector and screen
- Desktop or laptop computer
- Appropriate personal protective equipment
- Welding cables
- Lugs and quick disconnects
- Workpiece clamps
- Electrode holders
- Electrical plugs used with welding machines and matching electrical outlets
- Chipping hammers
- Wire brushes
- Files
- Pneumatic weld flux chipper
- Pneumatic needle scaler
- Transformer welding machine
- Transformer-rectifier welding machine
- Motor generator welding machine
- Engine-driven generator welding machine and alternator
(If any of these welding machines are unavailable, provide photos instead)
- 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 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.*

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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Shielded Metal Arc Welding</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. SMAW Safety</td>
<td></td>
</tr>
<tr>
<td>1. Moving Welding Equipment</td>
<td></td>
</tr>
<tr>
<td>2. Electrical Hazards</td>
<td></td>
</tr>
<tr>
<td>3. Lifting Hazards</td>
<td></td>
</tr>
<tr>
<td>4. Working at Heights</td>
<td></td>
</tr>
<tr>
<td>5. Welding Hazards</td>
<td></td>
</tr>
<tr>
<td>C. Welding Current</td>
<td></td>
</tr>
<tr>
<td>1. Types of Welding Current</td>
<td></td>
</tr>
<tr>
<td>2. Polarity</td>
<td></td>
</tr>
<tr>
<td>3. Characteristics of Welding Current</td>
<td></td>
</tr>
<tr>
<td>D. SMAW Machines</td>
<td></td>
</tr>
<tr>
<td>1. SMAW Machine Classifications</td>
<td></td>
</tr>
<tr>
<td>2. SMAW Machine Types</td>
<td></td>
</tr>
<tr>
<td>3. SMAW Machine Ratings</td>
<td></td>
</tr>
<tr>
<td>4. Welding Cable</td>
<td></td>
</tr>
<tr>
<td>5. SMAW Cable Connectors</td>
<td></td>
</tr>
<tr>
<td>E. SMAW Equipment Setup</td>
<td></td>
</tr>
<tr>
<td>1. Selecting the Proper SMAW Equipment</td>
<td></td>
</tr>
<tr>
<td>2. Welding Machine Location</td>
<td></td>
</tr>
<tr>
<td>3. Moving a Welding Machine</td>
<td></td>
</tr>
<tr>
<td>4. Stringing Welding Cable</td>
<td></td>
</tr>
<tr>
<td>5. Locating the Workpiece Clamp</td>
<td></td>
</tr>
<tr>
<td>F. Starting SMAW Welding Machines</td>
<td></td>
</tr>
<tr>
<td>1. Energizing Electrically Powered Welding Machines</td>
<td></td>
</tr>
<tr>
<td>2. Starting Engine-Driven Welding Machines</td>
<td></td>
</tr>
<tr>
<td>G. Tools for Cleaning Welds</td>
<td></td>
</tr>
<tr>
<td>1. Hand Tools</td>
<td></td>
</tr>
<tr>
<td>2. Pneumatic Cleaning and Slag Removal Tools</td>
<td></td>
</tr>
</tbody>
</table>
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
- Pencils and scratch paper
- Whiteboard/chalkboard
- Desktop or laptop computer
- Appropriate personal protective equipment
- Electrodes of various types
- Sample MSDS for an electrode
- Sample MSDS for a surface coating
- Multimedia projector and screen
- 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.
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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session I. Introduction; SMAW Electrodes; Review and Examination</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Shielded Metal Arc Welding Electrodes</td>
<td></td>
</tr>
<tr>
<td>C. AWS Filler Metal Specification System</td>
<td></td>
</tr>
<tr>
<td>1. Classification System</td>
<td></td>
</tr>
<tr>
<td>2. Manufacturers’ Classification</td>
<td></td>
</tr>
<tr>
<td>3. Electrode Sizes</td>
<td></td>
</tr>
<tr>
<td>D. Selecting Electrodes</td>
<td></td>
</tr>
<tr>
<td>1. Electrode Groups</td>
<td></td>
</tr>
<tr>
<td>2. Electrode Selection Considerations</td>
<td></td>
</tr>
<tr>
<td>E. Filler Metal Storage and Control</td>
<td></td>
</tr>
<tr>
<td>1. Code Requirements</td>
<td></td>
</tr>
<tr>
<td>2. Receiving Filler Metal</td>
<td></td>
</tr>
<tr>
<td>3. Storing Filler Metal</td>
<td></td>
</tr>
<tr>
<td>4. Storage Ovens</td>
<td></td>
</tr>
<tr>
<td>F. Filler Metal Traceability Requirements</td>
<td></td>
</tr>
<tr>
<td>G. Module Review</td>
<td></td>
</tr>
<tr>
<td>H. Module Examination</td>
<td></td>
</tr>
<tr>
<td>1. Trainees must score 70% or higher to receive recognition from the NCCER.</td>
<td></td>
</tr>
<tr>
<td>2. Record the testing results on Craft Training Report Form 200 and submit the results to the Training Program Sponsor.</td>
<td></td>
</tr>
</tbody>
</table>
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
Angle iron sections, ¾” 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.


**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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Shielded Metal Arc Welding – Beads and Fillet Welds</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Safety Summary</td>
<td></td>
</tr>
<tr>
<td>1. Protective Clothing and Equipment</td>
<td></td>
</tr>
<tr>
<td>2. Fire/Explosion Prevention</td>
<td></td>
</tr>
<tr>
<td>3. Work Area Ventilation</td>
<td></td>
</tr>
<tr>
<td>C. Arc Welding Equipment Setup</td>
<td></td>
</tr>
<tr>
<td>1. Preparing the Welding Area</td>
<td></td>
</tr>
<tr>
<td>2. Preparing the Weld Coupons</td>
<td></td>
</tr>
<tr>
<td>3. Electrodes</td>
<td></td>
</tr>
<tr>
<td>4. Preparing the Welding Machine</td>
<td></td>
</tr>
<tr>
<td>D. Striking an Arc</td>
<td></td>
</tr>
<tr>
<td>1. Scratching Method</td>
<td></td>
</tr>
<tr>
<td>2. Tapping Method</td>
<td></td>
</tr>
<tr>
<td>3. Practicing Striking and Extinguishing an Arc</td>
<td></td>
</tr>
<tr>
<td>E. Arc Blow</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Laboratory Practice and Performance Testing</strong></td>
<td></td>
</tr>
<tr>
<td>A. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Trainees practice setting up welding equipment, striking an arc, and extinguishing an arc. This laboratory corresponds to Performance Tasks 1 and 2.</td>
<td></td>
</tr>
</tbody>
</table>
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
- Pencils and scratch paper
- Whiteboard/chalkboard
- Multimedia projector and screen
- Desktop or laptop computer
- Appropriate personal protective equipment
- Straightedges
- Squares
- Levels
- Hi-Lo gauges
- Hydraulic jacks, chain hoists, come-alongs
- Strongbacks, clips, yokes, wedges
- Plate alignment tools
- Pipe jacks and rollers
- Chain clamps, cage clamps, rim clamps
- Small-diameter pipe clamping devices
- Pipe pullers
- Flange alignment tools
- Carbon steel plate and pipe of various sizes
- 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 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.


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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session I. Introduction; Joint Fit-Up and Alignment</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Job Code Specifications</td>
<td></td>
</tr>
<tr>
<td>1. Governing Codes and Standards</td>
<td></td>
</tr>
<tr>
<td>2. Code Changes</td>
<td></td>
</tr>
<tr>
<td>3. Welding Procedure Specifications</td>
<td></td>
</tr>
<tr>
<td>C. Fit-Up Gauges and Measuring Devices</td>
<td></td>
</tr>
<tr>
<td>1. Straightedges</td>
<td></td>
</tr>
<tr>
<td>2. Squares</td>
<td></td>
</tr>
<tr>
<td>3. Levels</td>
<td></td>
</tr>
<tr>
<td>4. Hi-Lo Gauges</td>
<td></td>
</tr>
<tr>
<td>D. Fit-Up Tools</td>
<td></td>
</tr>
<tr>
<td>1. Positioning Parts of a Weldment</td>
<td></td>
</tr>
<tr>
<td>2. Plate Fit-Up Tools</td>
<td></td>
</tr>
<tr>
<td>3. Pipe Fit-Up Tools</td>
<td></td>
</tr>
<tr>
<td>E. Weldment Distortion</td>
<td></td>
</tr>
<tr>
<td>1. Causes of Distortion</td>
<td></td>
</tr>
<tr>
<td>2. Correlation of Metal Properties and Distortion</td>
<td></td>
</tr>
<tr>
<td>3. Controlling Distortion</td>
<td></td>
</tr>
<tr>
<td>F. Checking Joint Misalignment and Poor Fit-Up</td>
<td></td>
</tr>
</tbody>
</table>
Session II. Laboratory; Review and Testing

A. Laboratory
   1. Trainees practice fitting up plate and pipe joints using applicable fit-up tools. This laboratory corresponds to Performance Task 1.
   2. Trainees practice checking fit-up of plate and pipe joints, using applicable gauges and other measuring devices. 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 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.
   2. Record the testing results on Craft Training Report 200 and submit the results to the Training Program Sponsor.
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
- Pencils and scratch paper
- Whiteboard/chalkboard
- Multimedia projector and screen
- Desktop or laptop computer
- Appropriate personal protective equipment
- Sample electrodes
- Carbon steel for practice coupons, ¼” thick minimum
- 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, ⅛” and ⅛” E7018 (or 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. 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.


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.

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Markers/chalk</td>
<td>Oxyfuel cutting equipment</td>
</tr>
<tr>
<td>Pencils and scratch paper</td>
<td>Welding shield or helmet</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td>Grinders</td>
</tr>
<tr>
<td>Welding 1 PowerPoint® Presentation Slides</td>
<td>Framing squares</td>
</tr>
<tr>
<td>Multimedia projector and screen</td>
<td>Pliers</td>
</tr>
<tr>
<td>Desktop or laptop computer</td>
<td>Friction lighters</td>
</tr>
<tr>
<td>Markers/chalk</td>
<td>Wire brush</td>
</tr>
<tr>
<td>Pencils and scratch paper</td>
<td>Chipping hammer</td>
</tr>
<tr>
<td>Appropriate personal protective equipment</td>
<td>Workpiece clamps</td>
</tr>
<tr>
<td>Sample electrodes</td>
<td>Electrode holder</td>
</tr>
<tr>
<td>Carbon steel for practice coupons, 1/4” thick minimum</td>
<td>Electrodes, E6010 and E7018 (or E6011 and E6013 for AC)</td>
</tr>
<tr>
<td>DC (or AC) welding machine</td>
<td>Module Examinations*</td>
</tr>
<tr>
<td>Welding bench with arm for position work</td>
<td>Performance Profile Sheets*</td>
</tr>
</tbody>
</table>

*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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session I. Introduction; Welding Equipment Setup</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Welding Equipment Setup</td>
<td></td>
</tr>
<tr>
<td>1. Safety Practices</td>
<td></td>
</tr>
<tr>
<td>2. Preparing the Welding Area</td>
<td></td>
</tr>
<tr>
<td>3. Preparing the Weld Coupons</td>
<td></td>
</tr>
<tr>
<td>4. Electrodes</td>
<td></td>
</tr>
<tr>
<td>5. Preparing the Welding Machine</td>
<td></td>
</tr>
<tr>
<td>C. Laboratory</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Session II. Open-Root V-Groove Welds; SMAW of Open-Root V-Groove Welds</td>
<td></td>
</tr>
<tr>
<td>A. Open-Root V-Groove Welds</td>
<td></td>
</tr>
<tr>
<td>1. Root Pass</td>
<td></td>
</tr>
<tr>
<td>2. Groove Weld Positions</td>
<td></td>
</tr>
<tr>
<td>3. Acceptable and Unacceptable Groove Weld Profiles</td>
<td></td>
</tr>
<tr>
<td>B. SMAW of Open-Root V-Groove Welds</td>
<td></td>
</tr>
<tr>
<td>1. Practicing Flat Open-Root V-Groove Welds (1G Position)</td>
<td></td>
</tr>
<tr>
<td>2. Horizontal Welds (2G Position)</td>
<td></td>
</tr>
<tr>
<td>3. Vertical Welds (3G Position)</td>
<td></td>
</tr>
<tr>
<td>4. Overhead Welds (4G Position)</td>
<td></td>
</tr>
</tbody>
</table>
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