Module One (29101-15) introduces trainees to the all-important topic of safety in the welding trade. The work of welders includes joining pipe sections for oil and natural gas pipelines; building ships; and working in a variety of industrial environments such as power plants, refineries, chemical plants, and manufacturing facilities.

### Objectives

#### Learning Objective 1
- Describe basic welding processes, the welding trade, and training/apprenticeship programs.
  - a. Describe basic welding processes and the welding trade.
  - b. Describe NCCER standardized training and explain apprenticeship programs.

#### Learning Objective 2
- Identify, and describe personal protective equipment (PPE) related to the welding trade.
  - a. Identify and describe body, foot, and hand protective gear.
  - b. Identify and describe ear, eye, face, and head protective gear.

#### Learning Objective 3
- Identify and describe welding safety practices related to specific hazards or environments.
  - a. Describe the importance of welding safety and identify factors related to accidents.
  - b. Describe basic welding safety practices related to the general work area.
  - c. Describe hot work permits and fire watch requirements.
  - d. Describe confined spaces and their related safety practices.
  - e. Identify safety practices related to welding equipment.
  - f. Identify and describe respiratory hazards, respiratory safety equipment, and ways to ventilate welding work areas.
  - g. Explain the purpose of the SDS/MSDS and how it is used.

### Performance Tasks

This is a knowledge-based module; there are no performance tasks.

### Teaching Time: 5 hours

(Two 2.5-Hour Classroom Sessions)

Session times may be adjusted to accommodate your class size, schedule, and teaching style.

### Prerequisites

Core Curriculum

### Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment, and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from www.nccerirc.com. The passing score for submission into NCCER’s Registry is 70% or above for the written examination; performance testing is graded pass or fail.
Safety Considerations
This module is primarily delivered in the classroom environment. However, some activities are likely to be conducted in shop areas and require trainees to handle common welding materials and tools. Safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to unseen hazards. Any deficiencies must be corrected to ensure future trainee safety.

Classroom Equipment and Materials
Whiteboard/chalkboard
Markers/chalk
Pencils and paper
Welding Level One PowerPoint® Presentation
DVD player or a computer with a DVD drive
LCD projector and screen
Computer with Internet access
Examples of SDSs/MSDSs
Copies of the Module Examination

Common welding PPE, including:
- Welding hood
- Head gear
- Face shield
- Jacket
- Apron
- Cape
- Arm covers
- Chaps
- Spats
- Tinted hood lenses
- Various types of respirators

Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study.


There are a number of on-line resources available for trainees who would like more information on this topic. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. There are a number of accessible videos related to welding safety on the Internet. Lincoln Electric Company offers a number of short, well-produced videos related to welding safety. The collection of videos can be found by visiting http://www.lincolnelectric.com/assets/us/en/interactive/welding-safety/ppe-home.html. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Instructors are also encouraged to locate additional audiovisual aids available on the Internet, make personal videos, and take still pictures related to the welding trade and add them to the PowerPoint® presentations throughout the program.
The Lesson Plan for this module consists of two 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break for each session.

**SESSION ONE**

Session One covers the first two objectives. It begins with acquainting the trainees with the welding trade and training required for it, and continues through selection and proper fit of PPE.

1. Use the Kickoff Activity to engage trainees in the topic and give them an idea of what they will learn from this session.
2. Show the Session One PowerPoint® presentation.
3. Define the welding processes and discuss the welding trade.
4. Review apprenticeship programs.
5. Describe and point out the differences between SMAW, GTAW, and GMAW.
6. Present welding-related PPE.
7. Introduce hot work permits, fire watches, and confined space operations.

**SESSION TWO**

Session Two presents various welding safety practices related to different environments and processes. At the end of this session, trainees will complete the written module examination.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to review Session One and introduce Session Two.
3. Discuss why it is important to practice welding safety.
4. Introduce the safety data sheets (SDSs) and material safety data sheets (MSDSs).
5. Administer the written examination.
6. Record the testing results on the Registration of Training Modules form, and submit the report to your Training Program Sponsor.
### Materials Checklist for Module 29101-15, Welding Safety

<table>
<thead>
<tr>
<th>Personal protective equipment:</th>
<th>Common welding PPE, including:</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Welding hood</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td>Head gear</td>
</tr>
<tr>
<td>Markers/chalk</td>
<td>Face shield</td>
</tr>
<tr>
<td>Pencils and paper</td>
<td>Jacket</td>
</tr>
<tr>
<td><em>Welding Level One</em></td>
<td></td>
</tr>
<tr>
<td>PowerPoint® Presentation</td>
<td>Apron</td>
</tr>
<tr>
<td>Slides</td>
<td></td>
</tr>
<tr>
<td>DVD player</td>
<td>Cape</td>
</tr>
<tr>
<td>Computer</td>
<td>Arm covers</td>
</tr>
<tr>
<td>Examples of SDSs/MSDSs</td>
<td>Chaps</td>
</tr>
<tr>
<td>Copies of the Module Examination</td>
<td>Spats</td>
</tr>
<tr>
<td>Tinted hood lenses</td>
<td></td>
</tr>
<tr>
<td>Various types of respirators</td>
<td></td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
**Module Two (29102-15)*** introduces the trainees to the methods and procedures of the oxyfuel cutting process. Trainees will learn safety procedures, equipment setup, fuel gas types, flow rates, and techniques. Hands-on practice and the completion of cutting-related Performance Tasks complete the learning process.

### Objectives

**Learning Objective 1**
- Describe oxyfuel cutting and identify related safe work practices.
  - a. Describe basic oxyfuel cutting.
  - b. Identify safe work practices related to oxyfuel cutting.

**Learning Objective 2**
- Identify and describe oxyfuel cutting equipment and consumables.
  - a. Identify and describe various gases and cylinders used for oxyfuel cutting.
  - b. Identify and describe hoses and various types of regulators.
  - c. Identify and describe cutting torches and tips.
  - d. Identify and describe other miscellaneous oxyfuel cutting accessories.
  - e. Identify and describe specialized cutting equipment.

**Learning Objective 3**
- Explain how to setup, light, and shut down oxyfuel equipment.
  - a. Explain how to properly prepare a torch set for operation.
  - b. Explain how to leak test oxyfuel equipment.
  - c. Explain how to light the torch and adjust for the proper flame.
  - d. Explain how to properly shut down oxyfuel cutting equipment.

**Learning Objective 4**
- Explain how to perform various oxyfuel cutting procedures.
  - a. Identify the appearance of both good and inferior cuts and their causes.
  - b. Explain how to cut both thick and thin steel.
  - c. Explain how to bevel, wash, and gouge.
  - d. Explain how to make straight and bevel cuts with portable oxyfuel cutting machines.

### Performance Tasks

**Performance Task 1 (Learning Objective 3)**
- Set up oxyfuel cutting equipment.

**Performance Task 2 (Learning Objective 3)**
- Light and adjust an oxyfuel torch.

**Performance Task 3 (Learning Objective 3)**
- Shut down oxyfuel cutting equipment.

**Performance Task 4 (Learning Objective 3)**
- Disassemble oxyfuel cutting equipment.

**Performance Task 5 (Learning Objective 3)**
- Change empty gas cylinders.

**Performance Task 6 (Learning Objective 4)**
- Cut shapes from various thicknesses of steel, emphasizing:
  - Straight line cutting
  - Square shape cutting
  - Piercing
  - Beveling
  - Cutting slot

**Performance Task 7 (Learning Objective 4)**
- Perform washing.

**Performance Task 8 (Learning Objective 4)**
- Perform gouging.

**Performance Task 9 (Learning Objective 4)**
- Use a track burner to cut straight lines and bevels.

### Teaching Time: 17.5 hours
(Seven 2.5-Hour Classroom Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

### Prerequisites

*Core Curriculum; Welding Level One, Module 29101-15.*
Before You Begin
As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider the time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from www.nccerirc.com. The passing score for submission into NCCER’s Registry is 70% or above for the written examination; performance testing is graded pass or fail.

Safety Considerations
This module requires that trainees work with a cutting torch, oxygen, and fuel gases, and very hot materials. Safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to hazards related to oxyfuel cutting equipment. Ensure all trainees use the proper lens tints to avoid eye damage and use the proper type of gloves. Any deficiencies must be corrected to ensure future trainee safety. All practice sessions and performance tasks must be completed under the instructor’s direct supervision.

Classroom Equipment and Materials
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- Welding Level One PowerPoint® presentation
- DVD player or a computer with a DVD drive
- LCD projector and screen
- Computer with Internet access
- Selection of usable and non-usable hoses
- Pressure regulators
- Assorted thin steel pieces cut and exhibiting distortion
- Module Review Question and Trade Terms Quiz answer keys
- Copies of the Module Examination and Performance Profile Sheets

Equipment and Materials for Laboratories and Performance Testing
- Appropriate PPE:
  - Appropriate flame-retardant clothing
  - Safety glasses
  - Welding gloves
  - Appropriate goggles or face shield
  - Proper footwear as designated by the instructor or training facility provider
  - Hearing protection as designated by the instructor or training facility provider
  - Oxygen cylinder
  - Fuel gas cylinder
  - Pressure regulators (oxygen and fuel gas)
  - Hose set
  - Cutting torches, combination or one-piece
- Assorted torch tips (cutting, washing, and gouging)
- Cylinder cart
- Files
- Squares
- Tape measure or steel rule
- Soapstone
- Common hand tools
- Chipping hammers
- Friction lighters
- Tip cleaners, drills, and files
- Approved leak testing solution
- Torch wrenches
- Sufficient carbon steel plate (≥¼" or 6 mm thick)
- Sufficient carbon steel plate (<¼" or 6 mm thick)
- Portable oxyfuel track burner

Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study:


There are a number of online resources available for trainees who would like more information on oxyfuel cutting. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. There are a number of accessible videos related to oxyfuel cutting on the Internet. For example, The Harris Products Group, a division of Lincoln Electric, offers well-produced videos related to oxyfuel cutting. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.
### Session One

Session One explains the oxyfuel cutting processes and identifies related safety precautions. Trainees will also be introduced to cylinder handling and storage. This session covers Sections 1.0.0 through 2.3.3.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and give them an idea of what they will learn from this module.
3. Describe basic oxyfuel or flame cutting processes.
4. Identify safe work practices, including PPE, fire/explosion prevention, and work area ventilation.
5. Identify precautions associated with cylinder handling and storage.
6. Describe how to identify oxyfuel cutting equipment and consumables.
7. Describe how to identify cutting torches and tips.

### Session Two

Session Two describes how the equipment is used to perform oxyfuel cutting, including the use of various gases, portable units, regulators, hoses, and cutting torches. This session covers Sections 2.4.0 through 3.4.2.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to review the information covered in the previous session.
3. Describe how to identify the specialized cutting equipment.
4. Describe how to properly prepare a torch for operation.
5. Describe how to leak-test oxyfuel equipment.
6. Describe how to light the torch and adjust for the proper flame.
7. Describe how to properly shut down oxyfuel cutting equipment.
**OXYFUEL CUTTING**

**SESSION THREE**

Session Three describes how to set up, light, and shut down oxyfuel equipment. This session covers Sections 4.0.0 through 4.4.3.

1. Show the Session Four PowerPoint® presentation.
2. Describe how to identify good cuts, inferior cuts, and their causes.
3. Describe how to cut thick steel and thin steel.
4. Describe straight, bevel, wash, and gouge techniques.
5. Describe how to make straight and bevel cuts with portable oxyfuel cutting machines.

**SESSION FOUR THROUGH SIX**

Sessions Four through Six are laboratory sessions.

1. Note that no PowerPoint® presentation is associated with this laboratory session.
2. Demonstrate how to set up oxyfuel equipment, light and adjust the oxyfuel torch, and change empty cylinders.
3. Demonstrate cutting shapes in thin and thick steel using the various cutting techniques discussed.
4. Demonstrate how to shut down oxyfuel cutting equipment.
5. Trainees practice and complete the specific tasks required by Performance Tasks 1 through 9.
6. The completion of all Performance Tasks can also be used towards completion of the Performance Accreditation Task.

**SESSION SEVEN**

Session Seven is a review and testing session. Have trainees complete the Module Review Questions and Trade Terms Quiz. Alternatively, these may be assigned as homework at the end of Session Six. Go over the Module Review questions in class prior to the exam and answer any questions that the trainees may have.

1. Have trainees complete the written examination. Any outstanding performance testing must be completed during this session as well.
2. Record the testing results on the Registration of Training Modules form, and submit the report to your Training Program Sponsor.
# Materials Checklist for Module 29102-15, Oxyfuel Cutting

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th>Materials Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal protective equipment:</strong></td>
<td>Selection of usable and non-usable hoses</td>
</tr>
<tr>
<td>Appropriate flame-retardant clothing</td>
<td>Assorted thin steel pieces cut and exhibiting distortion</td>
</tr>
<tr>
<td>Safety glasses</td>
<td>Fuel gas cylinder</td>
</tr>
<tr>
<td>Welding gloves</td>
<td>Hose set</td>
</tr>
<tr>
<td>Appropriate goggles or face shield</td>
<td>Assorted torch tips (cutting, washing, and gouging)</td>
</tr>
<tr>
<td>Proper footwear as designated by the instructor or training facility provider</td>
<td>Files</td>
</tr>
<tr>
<td>Hearing protection as designated by the instructor or training facility provider</td>
<td>Tape measure or steel rule</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td>Common hand tools</td>
</tr>
<tr>
<td>Markers/chalk</td>
<td>Friction lighters</td>
</tr>
<tr>
<td>Pencils and paper</td>
<td>Approved leak testing solution</td>
</tr>
<tr>
<td><strong>Welding Level One PowerPoint® Presentation Slides</strong></td>
<td>Sufficient carbon steel plate (≥¼” or 6 mm thick)</td>
</tr>
<tr>
<td>DVD player or a computer with a DVD drive</td>
<td>Portable oxyfuel track burner</td>
</tr>
<tr>
<td>Computer with internet access</td>
<td></td>
</tr>
<tr>
<td>Copies of the Module Examination and Performance Profile Sheets</td>
<td></td>
</tr>
<tr>
<td>Module Review Question and Trade Terms Quiz answer keys</td>
<td></td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
**Objectives**

**Learning Objective 1**
- Explain plasma arc cutting processes and identify related safety precautions.
  a. Describe the plasma arc cutting processes.
  b. Identify safety practices related to plasma arc cutting.

**Learning Objective 2**
- Identify and describe plasma arc cutting equipment.
  a. Identify and describe plasma arc power units.
  b. Identify and describe plasma arc torches and accessories.
  c. Identify and describe plasma arc cutting gases and gas control devices.

**Learning Objective 3**
- Describe how to set up, safely operate, and care for plasma arc cutting equipment.
  a. Describe how to set up plasma arc cutting equipment and the adjacent work area.
  b. Describe how to safely operate plasma arc cutting equipment.
  c. Describe how to care for plasma arc cutting equipment.

**Performance Tasks**

**Performance Task 1**  
* (Learning Objectives 1, 2, and 3)*  
- Set up plasma arc cutting equipment.

**Performance Task 2**  
* (Learning Objectives 2 and 3)*  
- Set the amperage and gas pressures or flow rates for the type and thickness of metal to be cut using plasma arc equipment.

**Performance Task 3**  
* (Learning Objective 3)*  
- Square-cut metal using plasma arc equipment.

**Performance Task 4**  
* (Learning Objective 3)*  
- Bevel-cut metal using plasma arc equipment.

**Performance Task 5**  
* (Learning Objective 3)*  
- Pierce and cut slots in metal using plasma arc equipment.

**Performance Task 6**  
* (Learning Objective 3)*  
- Dismantle and store the equipment.

**Teaching Time: 7.5 hours**  
(Three 2.5-Hour Classroom Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

**Prerequisites**

*Core Curriculum; Welding Level One, Module 29101-15.*

**Before You Begin**

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER’s Registry is 70% or above for the written examination; performance testing is graded pass or fail.
**Safety Considerations**

This module requires that trainees work with equipment that generates high voltages, extremely high temperatures, and intense ultraviolet radiation. Safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to hazards related to plasma arc cutting equipment. Any deficiencies must be corrected to ensure future trainee safety. All practice sessions and performance tasks must be completed under the instructor’s direct supervision.

---

**Classroom Equipment and Materials**

- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Welding Level One PowerPoint® Presentation*
- DVD player or a computer with a DVD drive
- LCD projector and screen
- Computer with Internet access
- Module Review and Trade Terms
- Quiz answer keys
- Copies of the Module Examination and Performance Profile Sheets
- An example of the plasma arc cutting unit and torch trainees will operate
- Manufacturer’s documentation for the cutting units to be used (a copy for each trainee is recommended)
- Gas cylinders and regulators (if required)

**Equipment and Materials for Laboratories and Performance Testing**

- Plasma arc cutting power units and accessories
- Clean, dry compressed air supply
- Other gases (if required)
- Gas pressure regulators (if required)
- Plasma torch cutting guides
- Sufficient carbon steel plate for all trainees to create the specified workpieces
- Soapstone
- Tape measures or steel rules
- Squares
- Wire brushes

---

**Additional Resources**

This module presents thorough resources for task training. The following resource material is suggested for further study:


There are a number of on-line resources available for trainees who would like more information on plasma arc cutting. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques. The Lincoln Electric web site at [http://newsroom.lincolnelectric.com/Video](http://newsroom.lincolnelectric.com/Video) offers a video entitled “Tech Tips: Plasma Cutting Basics” along with many other welding-related videos. Video length is 5:09.

Instructors are also encouraged to locate additional audiovisual aids available on the Internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.
The Lesson Plan for this module is divided into three 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

**Session One**

Session One explains plasma arc cutting (PAC) processes and identifies related safety precautions. The trainees will also be introduced to PAC power units, torches, accessories, gases and gas control devices. This session covers Sections 1.0.0 through 3.3.3.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and give them an idea of what they will learn from this module.
3. Describe plasma arc cutting processes and review safety considerations.
4. Introduce plasma arc cutting equipment.
5. Describe how to set up PAC equipment and prepare the adjacent work areas.
6. Describe how to safely operate the PAC equipment.
7. Review common cutting techniques.

**Session Two**

Session Two is a laboratory session that provides an opportunity to practice and/or complete the Performance Tasks required in this module.

1. Note that no PowerPoint® presentation is associated with this laboratory session.
2. Demonstrate equipment setup and plasma arc cutting techniques, including slots and bevels.
3. Trainees practice and/or complete the specific tasks required by Performance Tasks 1 through 6.

**Session Three**

Session Three is a review and testing session. Have trainees complete the Module Review Questions and Trade Terms Quiz. Alternatively, these may be assigned as homework at the end of the previous session. Go over the Module Review in class prior to the exam and answer any questions that the trainees may have.

1. Have trainees complete the written examination. Any outstanding performance testing must be completed during this session as well.
2. Record the testing results on the Registration of Training Modules form, and submit the report to your Training Program Sponsor.
## Materials Checklist for Module 29103-15, Plasma Arc Cutting

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th>Personal protective equipment:</th>
<th>Clean, dry compressed air supply</th>
<th>Tape measures or steel rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate flame-retardant clothing</td>
<td></td>
<td>Other gases (if required)</td>
<td>Wire brushes</td>
</tr>
<tr>
<td>Eye and face protection, properly tinted</td>
<td></td>
<td>Sufficient carbon steel plate for all trainees to create the specified workpieces</td>
<td>Squares</td>
</tr>
<tr>
<td>Welding or cutting gloves</td>
<td>Plasma arc cutting power units and accessories</td>
<td>Plasma torch cutting guides</td>
<td></td>
</tr>
<tr>
<td>Proper footwear as designated by the instructor or training facility provider</td>
<td>Gas pressure regulators (if required)</td>
<td>Soapstone</td>
<td></td>
</tr>
<tr>
<td>Hearing protection as designated by the instructor or training facility provider</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard hat or welding helmet as designated by the instructor or training facility provider</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Markers/chalk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pencils and paper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Welding Level One</em> PowerPoint® Presentation Slides</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DVD player or a computer with a DVD drive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer with Internet access</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copies of the Module Examination and Performance Profile Sheets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module Review and Trade Terms Quiz answer keys</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>An example of the plasma arc cutting unit and torch trainees will operate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturer’s documentation for the cutting units to be used (a copy for each trainee is recommended)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas cylinders and regulators (if required)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module Four (29104-15) introduces trainees to the methods and procedures related to air-carbon arc cutting and gouging processes. Trainees will identify related air-carbon arc cutting and gouging equipment and consumables, and will be tested on their ability to correctly and safely use this equipment.

Objectives

**Learning Objective 1**
- Define air-carbon arc cutting and identify the related equipment and consumables.
  a. Define air-carbon arc cutting.
  b. Identify and describe air-carbon arc cutting equipment.
  c. Identify and describe various types of electrodes.
  d. Identify safety practices related to air-carbon arc cutting.

**Learning Objective 2**
- Describe how to set up, safely operate, and care for air-carbon arc cutting equipment.
  a. Describe how to prepare the equipment and work area for air-carbon arc cutting.
  b. Describe how to wash and gouge metals.
  c. Describe how to care for air-carbon arc cutting equipment.

Performance Tasks

**Performance Task 1** (Learning Objectives 1 and 2)
- Select and install air-carbon arc cutting electrodes.

**Performance Task 2** (Learning Objective 2)
- Prepare the work area and air-carbon arc cutting equipment for safe operation.

**Performance Task 3** (Learning Objective 2)
- Use air-carbon arc cutting equipment for washing.

**Performance Task 4** (Learning Objective 2)
- Use air-carbon arc cutting equipment for gouging.

**Performance Task 5** (Learning Objective 2)
- Perform storage and housekeeping activities for air-carbon arc cutting equipment.

Teaching Time: 10.0 hours
(Four 2.5-Hour Classroom Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Prerequisites
Core Curriculum; Welding Level One, Module 29101-15.

Before You Begin
As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from www.nccerirc.com. The passing score for submission into NCCER's Registry is 70% or above for the written examination; performance testing is graded pass or fail.
**Classroom Equipment and Materials**

- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Welding Level One PowerPoint® Presentation*
- DVD player or a computer with a DVD drive
- LCD projector and screen
- Computer with Internet access
- Module Review and Trade Terms Quiz answer keys
- Copies of the Module Examination and Performance Profile Sheets
- A-CAC torch assembly, with cable/hoses
- Various sizes and shapes of A-CAC electrodes
- Manufacturer’s documentation for the welding equipment trainees will use (a copy for each trainee is recommended)

**Equipment and Materials for Laboratories and Performance Testing**

- Appropriate PPE:
  - Appropriate flame-retardant clothing
  - Safety glasses
  - Welding gloves
  - Welding helmets
  - Proper footwear as designated by the instructor or training facility provider
  - Hearing protection as designated by the instructor or training facility provider
  - Hard hat as designated by the instructor or training facility provider
- Welding equipment suitable for A-CAC operations, including electrode holders and cables/hoses
- Manufacturer’s documentation for the welding equipment to be used (a copy for each trainee is recommended)
- A-CAC electrodes of choice
- Sufficient carbon steel coupons for trainees to gouge and wash; it is suggested that fillet welds and other workpieces created by trainees in more advanced classes be used for this purpose.
- Grinders and grinding wheels
- Chipping hammers
- Wire brushes

**Additional Resources**

This module presents thorough resources for task training. The following resource material is suggested for further study.


There are a number of on-line resources available for trainees who would like more information on air-carbon arc cutting and gouging. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Instructors are also encouraged to locate additional audiovisual aids available on the Internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.

**Safety Considerations**

This module requires that trainees work with equipment that generates high currents and extreme heat. In addition, trainees will be working with compressed air and/or gases. Safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to unseen hazards related to the use of air-carbon arc cutting equipment. Any deficiencies must be corrected to ensure future trainee safety. All practice sessions and performance tasks must be completed under your direct supervision.
Session Outline for 29104-15

AIR-CARBON ARC CUTTING AND GOUGING

The Lesson Plan for this module is divided into four 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

SESSION ONE

Session One introduces air-carbon arc cutting (A-CAC) processes and reviews the related safety precautions. The trainees will also be introduced to A-CAC equipment and electrodes. This session covers Sections 1.0.0 through 1.4.3.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and share a unique task that can be accomplished using A-CAC equipment.
4. Introduce and discuss the various sizes and shapes of electrodes used in A-CAC work.
4. Review the safety precautions related to A-CAC processes.

SESSION TWO

Session Two explores the setup and safe operation of A-CAC equipment. A-CAC techniques are both presented and demonstrated. Laboratory activities conclude this session. This session covers Sections 2.0.0 through 2.3.1.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and review the content of the previous session.
3. Describe how to set up A-CAC equipment and prepare the adjacent work areas.
4. Discuss the techniques used to gouge and wash.
5. Trainees select the appropriate electrode and show how to properly position it in the electrode holder. This activity corresponds to Performance Task 1.
6. Trainees determine the proper equipment settings, properly set up the equipment, and prepare the work area for A-CAC. This activity corresponds to Performance Task 2.
7. Demonstrate the techniques for A-CAC washing and gouging.
8. Trainees shut down and prepare the equipment for storage. This activity corresponds to Performance Task 5.
Session Outline for 29104-15

**AIR-CARBONARC CUTTING AND GOUGING**

### Session Three

Session Three is a laboratory session that provides an opportunity to practice and/or complete the remaining Performance Tasks required in this module.

1. Note that no PowerPoint® presentation is associated with this laboratory session.
2. Trainees set up the equipment and prepare the work area for A-CAC equipment operation.
3. Trainees practice both gouging and washing. This activity corresponds to Performance Tasks 3 and 4.

### Session Four

Session Four is a review and testing session. Have trainees complete the Review Questions and Trade Terms Quiz. Alternatively, these may be assigned as homework at the end of the previous session. Go over the Review Questions in class prior to the exam and answer any questions that the trainees may have.

1. Have trainees complete the written examination. Any outstanding performance testing must be completed during this session as well.
2. Record the testing results on the Registration of Training Modules form, and submit the report to your Training Program Sponsor.
## Materials Checklist for Module 29104-15, Air-Carbon Arc Cutting and Gouging

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th>Grinders and grinding wheels</th>
<th>Chipping hammers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal protective equipment:</td>
<td>Wire brushes</td>
<td>Welding equipment suitable for A-CAC operations, including electrode holders and cables/hoses</td>
</tr>
<tr>
<td>Appropriate flame-retardant clothing</td>
<td>A-CAC electrodes of choice</td>
<td>Sufficient carbon steel coupons for trainees to gouge and wash; it is suggested that fillet welds and other workpieces created by trainees in more advanced classes be used for this purpose.</td>
</tr>
<tr>
<td>Safety glasses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welding gloves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welding helmets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proper footwear as designated by the instructor or training facility provider</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hearing protection as designated by the instructor or training facility provider</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard hat as designated by the instructor or training facility provider</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Markers/chalk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pencils and paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Welding Level One</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PowerPoint© Presentation Slides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DVD player or a computer with a DVD drive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer with Internet access</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copies of the Module Examination and Performance Profile Sheets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module Review and Trade Terms Quiz answer keys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-CAC torch assembly, with cable/hoses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Various sizes and shapes of A-CAC electrodes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturer’s documentation for the welding equipment trainees will use (a copy for each trainee is recommended)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module Five (29105-15) introduces the trainees to the methods and procedures related to preparing base metal for welding. Trainees will learn safety procedures, welding joint preparation, specifications, identification of physical characteristics, mechanical properties, and cleaning techniques related to common base metals.

Objectives
Learning Objective 1
• Identify safety practices related to preparing base metals and describe basic cleaning procedures.
  a. Identify safety practices related to preparing base metals.
  b. Describe the basic properties and types of carbon and stainless steel.
  c. Describe basic metal cleaning procedures and concerns.

Learning Objective 2
• Identify and describe basic weld joint design and types of welds.
  a. Identify and describe the loads that are routinely placed on weld joints.
  b. Identify and describe the various types of weld joints.
  c. Describe a welding procedure specification (WPS) and the information it provides.

Learning Objective 3
• Describe how to prepare joints for welding.
  a. Describe how to mechanically prepare joints for welding.
  b. Describe how to thermally prepare joints for welding.

Performance Tasks
Performance Task 1 (Learning Objectives 1 and 3)
• Mechanically or hand grind a bevel on the edge of a ¼”- to ¾”-thick mild steel plate (6 to 20 mm metric plate) at 22½ degrees.

Performance Task 2 (Learning Objectives 1 and 3)
• Thermally bevel the edge of a ¼”- to ¾”-thick mild steel plate (6 to 20 mm metric plate) at 22½ degrees.

Teaching Time: 12.5 hours
(Five 2.5-Hour Classroom Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Prerequisites
Core Curriculum; Welding Level One, Module 29101-15.

Before You Begin
As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider the time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from www.nccerirc.com. The passing score for submission into NCCER’s Registry is 70% or above for the written examination; performance testing is graded pass or fail.
Safety Considerations
This module requires that trainees work with power tools, flammable gases, and an open flame. Safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to unseen hazards related to base metal preparation. Any deficiencies must be corrected to ensure future trainee safety. All practice sessions and performance tasks must be completed under your direct supervision.

Classroom Equipment and Materials
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Welding Level One PowerPoint® Presentation*
- DVD player or a computer with a DVD drive
- LCD projector and screen
- Computer with Internet access
- Module Review and Trade Terms Quiz answer keys
- Copies of the Module Examination and Performance Profile Sheets
- Copies of an SDS/MSDS for a metal cleaning chemical
- Examples of workpieces prepared for welding, matching the common joint styles
- Examples of weld joint backing tapes
- Copies of various WPSs

Equipment and Materials for Laboratories and Performance Testing
- Appropriate PPE:
  - Appropriate flame-resistant clothing
  - Safety glasses
  - Face shields
  - Properly-tinted goggles or face shields
  - Work gloves
  - Welding gloves
  - Proper footwear as designated by the instructor or training facility provider
  - Hearing protection as designated by the instructor or training facility provider
  - Hard hat as designated by the instructor or training facility provider
  - Angle and/or die grinders
  - Grinding wheels and points
- Nibblers and/or cutters
- Tape measure or steel rule
- Squares
- Files
- Wire brushes
- Soapstone
- Common hand tools
- ¼” to ⅝” thick mild steel plate (6 to 20 mm metric plate)
- Oxyfuel cutting equipment, including hoses and torches
- Track burner (optional)
- Gas regulators
- Oxygen cylinders
- Fuel gas cylinders
- Chipping hammers

Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study.

- Association for Iron & Steel Technology, 186 Thorn Hill Road, Warrendale, PA, USA. www.aist.org
- “How to Weld: Joint Prep and Beveling” Independent Video, last accessed November 26, 2014. www.youtube.com

There are a number of online resources available for trainees who would like more information on base metal preparation. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

There are also numerous videos available on the Internet related to base metal preparation. These can be located by searching “weld joint preparation” or “beveling plate” and using the Video tab on the results page of your preferred search engine.
The Lesson Plan for this module is divided into five 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

**Session One**

Session One introduces trainees to basic welding safety and cleaning, including basic metal cleaning procedures and concerns. This session will also introduce basic properties and types of carbon and stainless steel. This session covers Sections 1.0.0 through 1.3.2.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and give them an idea of what they will learn from this module.
3. Review the safety practices related to welding and base metal preparation.
4. Discuss the common properties of carbon steel and stainless steel.
5. Describe base metal cleaning using both chemicals and mechanical methods.

**Session Two**

Session Two introduces the trainees to joint design and weld types. This session covers Sections 2.0.0 through 3.2.0.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to review material presented in the previous session.
3. Describe the types of loads that are commonly imposed on weld joints.
4. Present different types of weld joints.
5. Explain codes and review welding procedure specifications.
7. Review the thermal methods of joint preparation.

**Session Three**

Session Three is a laboratory session that provides an opportunity to practice and/or complete the Performance Tasks associated with mechanical welding joint preparation.

1. Note that no PowerPoint® presentation is associated with this laboratory session.
2. Demonstrate how to properly and safely bevel plate using various power tools.
3. Trainees practice and/or complete the requirements of Performance Task 1.

**Session Four**

Session Four is a laboratory session that provides an opportunity to practice and/or complete the Performance Tasks associated with thermal welding joint preparation.

1. Note that no PowerPoint® presentation is associated with this session.
2. Demonstrate how to properly and safely bevel plate using selected oxyfuel and/or plasma arcing cutting equipment.
3. Trainees practice and/or complete the requirements of Performance Task 2.

**Session Five**

Session Five is a review and testing session. Have trainees complete the Module Review Questions and Trade Terms Quiz. (Alternatively, these may be assigned as homework at the end of Session Four.) Go over the Module Review Questions in class prior to the exam and answer any questions that the trainees may have.

1. Have trainees complete the written examination. Any outstanding performance testing must be completed during this session as well.
2. Record the testing results on the Registration of Training Modules form, and submit the report to your Training Program Sponsor.
### Equipment and Materials

<table>
<thead>
<tr>
<th>Personal protective equipment:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas regulators</td>
<td>Chipping hammers</td>
<td></td>
</tr>
<tr>
<td>Oxygen cylinders</td>
<td>Fuel gas cylinders</td>
<td></td>
</tr>
<tr>
<td>Angle and/or die grinders</td>
<td>Grinding wheels and points</td>
<td></td>
</tr>
<tr>
<td>Nibblers and/or cutters</td>
<td>Tape measure or steel rule</td>
<td></td>
</tr>
<tr>
<td>Squares</td>
<td>Files</td>
<td></td>
</tr>
<tr>
<td>Wire brushes</td>
<td>Soapstone</td>
<td></td>
</tr>
<tr>
<td>Common hand tools</td>
<td>¼” to ½” thick mild steel plate (6 to 20 mm metric plate)</td>
<td></td>
</tr>
<tr>
<td>Oxyfuel cutting equipment, including hoses and torches</td>
<td>Track burner (optional)</td>
<td></td>
</tr>
<tr>
<td>Hearing protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hearing protection as designated by the instructor or training facility provider</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard hat as designated by the instructor or training facility provider</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Whiteboard/chalkboard</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Markers/chalk</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Pencils and paper</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Welding Level One PowerPoint® Presentation Slides</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>DVD player</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Computer</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Copies of the Module Examination and Performance Profile Sheets</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module Review and Trade Terms Quiz answer keys</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Copies of an SDS/MSDS for a metal cleaning chemical</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Examples of workpieces prepared for welding, matching the common joint styles</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Examples of weld joint backing tapes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Copies of various WPSs</th>
</tr>
</thead>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module Six (29106-15) introduces trainees to the methods and procedures to produce high-quality welds. Trainees will become familiar with welding codes and provisions, discontinuities, examination practices, and weld procedure testing. Trainees will then complete a visual inspection on a fillet and/or groove weld and complete an inspection report to document the results.

Objectives

Learning Objective 1
- Identify and describe the various code organizations that apply to welding and their basic elements.
  a. Identify the various welding code organizations and their sponsoring organizations.
  b. Identify and describe the basic provisions of welding codes.

Learning Objective 2
- Identify and describe weld discontinuities and their causes.
  a. Identify and describe discontinuities related to porosity and inclusions.
  b. Identify and describe discontinuities that result in cracking.
  c. Identify and describe discontinuities related to joint penetration, fusion, and undercutting.
  d. Identify and describe acceptable and unacceptable weld profiles.

Learning Objective 3
- Describe various non-destructive and destructive weld examination practices.
  a. Describe basic visual inspection methods including measuring devices and liquid penetrants.
  b. Describe magnetic particle and electromagnetic inspection processes.
  c. Describe the radiographic and ultrasonic inspection processes.
  d. Describe destructive testing processes.

Learning Objective 4
- Describe the welder performance testing process.
  a. Describe the qualification of welders by position.
  b. Describe welder qualification testing to meet American Welding Society (AWS) and American Society of Mechanical Engineers (ASME) requirements.
  c. Describe the process for completing a weld test.

Performance Task

Performance Task 1
(Learning Objectives 2 and 3)
- Perform a visual inspection (VT) on a fillet and/or groove weld and complete an inspection report.

Teaching Time: 10.0 hours
(Four 2.5-Hour Classroom Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Prerequisites

Core Curriculum; Welding Level One, Module 29101-15.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from www.nccerirc.com. The passing score for submission into NCCER’s Registry is 70% or above for the written examination; performance testing is graded pass or fail.
**Safety Considerations**

Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to hazards related to the welding environment. Although no welding tasks are associated with this module, trainees will likely be in the vicinity of welding operations and the related equipment. Any deficiencies in safety practices must be corrected to ensure future trainee safety.

---

**Classroom Equipment and Materials**

- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Welding Level One* PowerPoint® Presentation
- DVD player or a computer with a DVD drive
- LCD projector and screen
- Computer with Internet access
- Module Review Question and Trade Terms Quiz answer keys
- Copies of the Module Examination and Performance Profile sheets
- Examples and/or excerpts from various welding codes
- Undercut gauge
- Butt-weld reinforcement gauge
- Fillet-weld blade gauge set
- Liquid penetrant and appropriate developer
- Fillet and groove weld coupons to demonstrate the use of inspection tools

---

**Equipment and Materials for Laboratories and Performance Testing**

- Appropriate PPE:
  - Safety glasses
  - Work gloves
- Completed fillet weld coupons using ¼” (6 mm) plate; minimum of 6” (15.2 cm) long
- Completed joint-penetration groove weld coupons; minimum of 6” (15.2 cm) long
- Undercut gauges
- Butt weld reinforcement gauges
- Fillet weld blade gauge sets
- Copies of the Visual Test Inspection Report (found in the Appendix of the Trainee Guide)

---

**Additional Resources**

This module presents thorough resources for task training. The following resource material is suggested for further study:


There are a number of on-line resources available for trainees who would like more information on weld quality and inspection. A search for additional information may be assigned as homework to interested trainees. The additional resources listed in the Trainee Guide and in this lesson plan identify excellent resources for further learning.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

There are also numerous videos available on the Internet related to weld inspection. These can be located by using the search term “weld inspection” and using the video tab on the results page of your preferred search engine.
The Lesson Plan for this module is divided into four 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

**SESSION ONE**

Session One presents basic codes, standards, and specifications. It covers Sections 1.0.0 through 2.4.0 of the module. The various types of weld discontinuities are discussed.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and give them an idea of what they will learn from this module.
3. Describe the welding codes and their related organizations.
4. Present basic provisions of welding codes.
5. Define discontinuities.
6. Describe how to identify porosity and inclusions.
7. Describe how to identify cracking or conditions that can lead to cracking.
8. Describe discontinuities related to joint penetration, fusion, and undercutting.
9. Show the difference between acceptable and unacceptable weld profiles.

**SESSION TWO**

Session Two describes various non-destructive and destructive weld testing procedures, along with welder qualification testing. This session covers Sections 3.0.0 through 4.3.4 of the module.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to review the information covered in the previous session.
3. Demonstrate how to use tools to do a visual inspection.
4. Describe magnetic particle and electromagnetic inspections.
5. Describe radiographic and ultrasonic inspections.
6. Discuss destructive testing processes.
7. Describe welding qualification by position.
8. Describe the process for completing a welder qualification test.
Session Three

Session Three is a laboratory session devoted to the completion of Performance Task 1 and practice in using weld measurement gauges.

1. Note that no PowerPoint® presentation is associated with this laboratory session.

2. Demonstrate to the trainees how the discontinuities can be found within the sample weld using the appropriate test instruments.

3. Have the trainees practice using weld measurement gauges.

4. Demonstrate how to fill out the Visual Test Inspection Report.

5. Trainees practice and/or complete the specific tasks required by Performance Task 1.

Session Four

Session Four is a review and testing session. Have trainees complete the Module Review Questions and Trade Terms Quiz. Alternatively, these may be assigned as homework at the end of Session Three. Go over the Module Review questions in class prior to the exam and answer any questions that the trainees may have.

1. Have trainees complete the written examination. Any outstanding performance testing must be completed during this session as well.

2. Record the testing results on the Registration of Training Modules form, and submit the report to your Training Program Sponsor.
### Materials Checklist for Module 29106-15, Weld Quality

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th>Examples and/or excerpts from various welding codes</th>
<th>Undercut gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal protective equipment:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety glasses</td>
<td>Butt-weld reinforcement gauge</td>
<td>Fillt-weld blade gauge set</td>
</tr>
<tr>
<td>Work gloves</td>
<td>Liquid penetrant and appropriate developer</td>
<td>Fillt and groove weld coupons to demonstrate the use of inspection tools</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td>Completed fillt weld coupons using ¼” (6 mm) plate; minimum of 6” (15.2 cm) long</td>
<td>Completed joint-penetration groove weld coupons; minimum of 6” (15.2 cm) long</td>
</tr>
<tr>
<td>Markers/chalk</td>
<td>Undercut gauges</td>
<td>Butt weld reinforcement gauges</td>
</tr>
<tr>
<td>Pencils and paper</td>
<td>Fillet weld blade gauge sets</td>
<td>Copies of the Visual Test Inspection Report (found in the Appendix of the Trainee Guide)</td>
</tr>
<tr>
<td><strong>Welding Level One PowerPoint® Presentation Slides</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DVD player</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copies of the Module Examination and Performance Profile sheets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module Review Question and Trade Terms Quiz answer keys</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module Seven (29107-15) introduces the trainees to methods and procedures related to setting up SMAW equipment. Trainees will learn safety procedures, current characteristics, various kinds of SMAW equipment, and maintenance.

### Objectives

**Learning Objective 1**
- Identify SMAW-related safety practices and explain how electrical characteristics apply to SMAW.
  - Define SMAW and identify related safety practices.
  - Explain how various current characteristics apply to SMAW.

**Learning Objective 2**
- Identify and describe SMAW equipment.
  - Identify and describe various types of SMAW machines.
  - Identify and describe SMAW welding cable and connectors.
  - Identify common tools used to clean a weld.

**Learning Objective 3**
- Explain how to set up and start SMAW equipment.
  - Explain how to set up SMAW equipment.
  - Explain how to start, stop, and maintain SMAW equipment.

### Performance Task

**Performance Task 1**
(learning Objectives 2 and 3)
- Set up a machine for SMAW.

### Teaching Time: 5 hours
(Two 2.5-Hour Classroom Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

### Prerequisites
*Core Curriculum; Welding Level One, Module 29101-15.*

### Before You Begin
As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER’s Registry is 70% or above for the written examination; performance testing is graded pass or fail.
Safety Considerations
Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to hazards related to the welding environment. Although no welding tasks are associated with this module, trainees will likely be in the vicinity of welding operations and the related equipment. Any deficiencies in safety practices must be corrected to ensure future trainee safety.

Classroom Equipment and Materials
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Welding Level One* PowerPoint® Presentation
- DVD player or a computer with a DVD drive
- LCD projector and screen
- Computer with Internet access
- Module Review Question and Trade Terms Quiz answer keys
- Copies of the Module Examination and Performance Profile Sheets
- Terminal lugs
- Quick-disconnects
- Welding cables
- Workpiece clamps
- Electrode holders
- Tools used for cleaning welds and base metals

Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study.


There are a number of online resources available for trainees who would like more information on SMAW equipment. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

There are also numerous videos available on the Internet related to SMAW equipment setup. These can be located by using the term “What is an arc welding machine?” and using the Video tab on the results page of your preferred search engine.

Instructors are also encouraged to locate additional audiovisual aids available on the Internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.

Equipment and Materials for Laboratories and Performance Testing
- Appropriate PPE:
  - Safety glasses
  - Welding gloves
  - Welding shield or helmet
  - Proper footwear as directed by the instructor or training facility provider
  - Hearing protection as directed by the instructor or training facility provider
  - Hard hat as directed by the instructor or training facility provider
- Welding machine and cables suitable for SMAW operations
- Manufacturer’s documentation for the welding equipment to be used (a copy for each trainee is recommended)

Appropriate PPE:
- Safety glasses
- Welding gloves
- Welding shield or helmet
- Proper footwear as directed by the instructor or training facility provider
- Hearing protection as directed by the instructor or training facility provider
- Hard hat as directed by the instructor or training facility provider
- Welding machine and cables suitable for SMAW operations
- Manufacturer’s documentation for the welding equipment to be used (a copy for each trainee is recommended)
The Lesson Plan for this module is divided into two 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

**SESSION ONE**

Session One introduces trainees to safe practices, current characteristics, tools, equipment and SMAW equipment setup. It covers Sections 1.0.0 through 3.2.4 of the module.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and give them an idea of what they will learn from this module.
3. Explain that safety must be maintained and appropriate protective clothing and PPE must be worn.
4. Explain how various current characteristics apply to SMAW.
5. Identify common tools used to clean a weld.
6. Identify and describe SMAW welding cable connections.
7. Identify common tools used to clean a weld.
8. Explain how to set up SMAW equipment.
9. Explain how to start, stop and maintain SMAW equipment.
10. Demonstrate how to set up SMAW equipment.

**SESSION TWO**

Session Two introduces the trainees to the laboratory sessions for practice and completion of the performance tasks. Go over the Module Review questions in class prior to the exam and answer any questions that the trainees may have.

1. Note that no PowerPoint® presentation is associated with this laboratory session.
2. Use the Kickoff Activity to help trainees review what they have learned in these sessions.
3. Trainees practice and/or complete the demonstrated tasks associated with Performance Task 1.
4. Have trainees complete the written examination. Any outstanding performance testing must be completed during this session as well.
5. Record the testing results on the Registration of Training Modules form, and submit the report to your Training Program Sponsor.
## Materials Checklist for Module 29107-15, SMAW – Equipment and Setup

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal protective equipment:</strong></td>
</tr>
<tr>
<td>Terminal lugs</td>
</tr>
<tr>
<td>Safety glasses</td>
</tr>
<tr>
<td>Welding gloves</td>
</tr>
<tr>
<td>Welding shield or helmet</td>
</tr>
<tr>
<td>Proper footwear as directed by the instructor or training facility provider</td>
</tr>
<tr>
<td>Hearing protection as directed by the instructor or training facility provider</td>
</tr>
<tr>
<td>Hard hat as directed by the instructor or training facility provider</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
</tr>
<tr>
<td>Markers/chalk</td>
</tr>
<tr>
<td>Pencils and paper</td>
</tr>
<tr>
<td><strong>Welding Level One PowerPoint® Presentation Slides</strong></td>
</tr>
<tr>
<td>DVD player</td>
</tr>
<tr>
<td>Computer</td>
</tr>
<tr>
<td>Copies of the Module Examination and Performance Profile Sheets</td>
</tr>
<tr>
<td>Module Review Question and TradeTerms Quiz answer keys</td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module Eight (29108-15) introduces the trainees to the selection, classification, and use of electrodes for arc welding. Trainees will become familiar with the various types of electrodes, their uses, identification, handling, and proper storage.

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Performance Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning Objective 1</strong></td>
<td>This is a knowledge-based module; there are no performance tasks.</td>
</tr>
<tr>
<td>1. Describe the SMAW electrode classification system and how to select the proper electrode for the task.</td>
<td></td>
</tr>
<tr>
<td>a. Describe the AWS filler metal specification system and various electrode characteristics.</td>
<td></td>
</tr>
<tr>
<td>b. Describe the characteristics of the four main electrode groups.</td>
<td></td>
</tr>
<tr>
<td><strong>Learning Objective 2</strong></td>
<td></td>
</tr>
<tr>
<td>2. Explain how to select electrodes and describe their proper care and handling.</td>
<td></td>
</tr>
<tr>
<td>a. Identify various considerations in the selection of the proper electrode.</td>
<td></td>
</tr>
<tr>
<td>b. Describe the proper handling and storage of electrodes.</td>
<td></td>
</tr>
</tbody>
</table>

**Teaching Time: 2.5 hours**
(One 2.5-Hour Session)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

**Prerequisites**
*Core Curriculum; Welding Level One, Module 29101-15.*

**Before You Begin**
As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER’s Registry is 70% or above for the written examination; performance testing is graded pass or fail.
Safety Considerations
Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to hazards related to the welding environment. Although no welding tasks are associated with this module, trainees will likely be in the vicinity of welding operations and the related equipment. Any deficiencies in safety practices must be corrected to ensure future trainee safety.

Classroom Equipment and Materials
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- Welding Level One PowerPoint® Presentation
- DVD player or a computer with a DVD drive
- LCD projector and screen
- Computer with Internet access
- Module Review Question and Trade Terms Quiz answer keys
- Copies of the Module Examination
- Examples of ASW welding specifications
- Examples of various welding electrodes:
  - Fast-freeze electrodes – E6010, E6011, and E7010
  - Fill-freeze electrodes – E6012, E6013, and E7014
  - Fast-fill electrodes – E6027, E7024, and E7028
  - Low-hydrogen electrodes – E7016, E7018, E7028, and E7048
- Examples of welds made with incompatible electrodes

Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study:


There are a number of on-line resources available for trainees who would like more information on SMAW electrodes. A search for additional information may be assigned as homework to interested trainees. The additional resources listed in the Trainee Guide and in this lesson plan identify excellent resources for further learning.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

There are also numerous videos available on the Internet related to SMAW electrodes. These can be located by using the search term “How to select rods for arc welding” and using the Video tab on the results page of your preferred search engine.

Instructors are also encouraged to locate additional audiovisual aids available on the Internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.
Session Outline for 29108-15

SMAW ELECTRODES

The Lesson Plan for this module consists of one 2.5-hour session. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

SESSION ONE

Session One presents SMAW electrode selection criteria, classification, characteristics, care, handling and storage. This session also includes coverage of the AWS filler metal specification system.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and give them an idea of what they will learn from this module.
3. Describe the SMAW electrode classification system.
4. Describe the AWS filler metal specifications system.
5. Explain how to select an electrode and what to consider before the selection is made.
6. Describe the proper handling care and storage of electrodes.
7. Go over the Module Review questions and trade terms in class prior to the exam and answer any questions that the trainees may have.
8. Have trainees complete the written examination.
9. Record the testing results on Registration of Training Modules Form, and submit the report to your Training Program Sponsor.
## Materials Checklist for Module 29108-15, SMAW Electrodes

<table>
<thead>
<tr>
<th>Personal protective equipment:</th>
<th>Examples of various welding electrodes:</th>
<th>Examples of welds made with incompatible electrodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Fast-freeze electrodes – E6010, E6011, and E7010</td>
<td>Examples of ASW welding specifications</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td>Fast-fill electrodes – E6027, E7024, and E7028</td>
<td></td>
</tr>
<tr>
<td>Markers/chalk</td>
<td>Fill-freeze electrodes – E6012, E6013, and E7014</td>
<td></td>
</tr>
<tr>
<td>Pencils and paper</td>
<td>Low-hydrogen electrodes – E7016, E7018, E7028, and E7048</td>
<td></td>
</tr>
</tbody>
</table>

*Welding Level One*  
PowerPoint® Presentation  
Slides  
DVD player  
Computer  
Copies of the Module Examination  
Module Review Question and Trade Terms Quiz answer keys

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module Nine (29109-15) introduces the methods and procedures related to SMAW beads and fillet welding. Trainees will learn safety procedures, equipment setup, how to strike an arc, and how to produce weave beads and stringer beads. Hands-on practice and the completion of welding-related Performance Tasks complete the learning process.

### Objectives

**Learning Objective 1**
- Explain how to prepare for SMAW welding and how to strike an arc.
  - a. Identify safety practices related to SMAW.
  - b. Explain how to prepare the area and equipment for welding.
  - c. Explain how to strike an arc and respond to arc blow.

**Learning Objective 2**
- Explain how to successfully complete various types of beads and welds.
  - a. Explain how to properly restart and terminate a weld pass.
  - b. Describe the technique required to produce stringer beads.
  - c. Describe the technique required to produce weave and overlapping beads.
  - d. Describe the techniques required to produce fillet welds in various positions.

### Performance Tasks

**Performance Task 1** (Learning Objective 1)
- Set up welding equipment.

**Performance Task 2** (Learning Objective 1)
- Strike an arc.

**Performance Task 3** (Learning Objective 2)
- Make stringer, weave, and overlapping beads using E6010 and E7018 electrodes.

**Performance Task 4** (Learning Objective 2)
- Make corner welds on an angle iron section end welded to a plate coupon.

**Performance Task 5** (Learning Objective 2)
- Make fillet welds using E6010 and E7018 electrodes in the specified positions:
  - Flat (1F)
  - Horizontal (2F)
  - Vertical (3F)
  - Overhead (4F)

### Teaching Time: 100 hours

(Forty 2.5-Hour Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

### Prerequisites

*Core Curriculum; Welding Level One, Module 29101-15.*

### Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER's Registry is 70% or above for the written examination; performance testing is graded pass or fail.
Safety Considerations
This module requires that trainees work with equipment that generates high currents and extreme heat. In addition, trainees will be working with compressed air and/or gases. Safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to unseen hazards related to the use of this equipment. Any deficiencies must be corrected to ensure future trainee safety. All practice sessions and performance tasks must be completed under your direct supervision.

Classroom Equipment and Materials
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Welding Level One PowerPoint®* Presentation
- DVD player or a computer with a DVD drive
- LCD projector and screen
- Computer with Internet access
- Review Question and Trade Terms
- Quiz answer keys
- Copies of the Module Examination and Performance Profile Sheets

Equipment and Materials for Laboratories and Performance Testing
- Appropriate PPE:
  - Appropriate flame-retardant clothing
  - Safety glasses
  - Welding shield or helmet
  - Properly-tinted goggles or face shields
  - Work gloves
  - Welding gloves
  - Proper footwear as designated by the instructor or training facility provider
  - Hearing protection as designated by the instructor or training facility provider
  - Hard hat as designated by the instructor or training facility provider
  - Angle and/or die grinders
  - Grinding wheels
- Welding equipment suitable for SMAW welding operations
- Welding benches with arm for position work
- Cutting equipment (appropriate saws or oxyfuel cutting equipment)
- Tape measure or steel rules
- Squares
- Files
- Wire brushes
- Soapstone
- Chipping hammer
- Common hand tools
- ¼” to ¾” thick mild steel plate (6 to 20 mm metric plate)
- ¾” angle iron sections (5 mm metric)
- Electrode types E6010 or E6011, and E7018

Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study.


There are a number of online resources available for trainees who would like more information on SMAW welding. A search for additional information may be assigned as homework to interested trainees. Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

There are also numerous videos available on the internet related to SMAW welding. These can be located by searching on terms such as “SMAW welding technique” or similar terms and using the Video tab on the results page of your preferred search engine.

Instructors are also encouraged to locate additional audiovisual aids available on the internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.
The Lesson Plan for this module is divided into forty 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

**SESSION ONE**

Session One introduces trainees to SMAW safety. In addition, trainees learn how to prepare the work area; how to prepare the necessary equipment; and how to strike and maintain an arc. This session covers Sections 1.0.0 through 1.3.4.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and give them an idea of what they will learn from this module.
3. Describe the safety practices related to SMAW.
4. Discuss how to prepare the equipment and the work area for welding.
5. Describe the proper way to strike an arc.

**SESSION TWO**

Session Two introduces SMAW welding techniques, including stringer beads, weave beads, bead termination, and arc restart. This session covers Sections 2.0.0 through 2.4.7.

1. Show the Session Two PowerPoint® presentation.
2. Explain how to perform a restart and termination of a weld pass.
3. Describe the required technique to produce stringer beads.
4. Describe the techniques required to make overlapping and weave beads.
5. Describe the techniques to produce fillet welds in a variety of positions.

**SESSIONS THREE THROUGH THIRTY-NINE**

Sessions Three through Thirty-Nine are laboratory sessions that provides an opportunity to practice and/or complete the Performance Tasks associated with SMAW welding.

1. Note that no PowerPoint® presentations are associated with these sessions.
2. Demonstrate how to safely perform the specific requirements of Performance Tasks 1 through 5.
3. Trainees practice and/or complete the demonstrated tasks associated with Performance Tasks 1 through 5 through this series of sessions.

**SESSION FORTY**

Session Forty is a review and testing session. Have trainees complete the Module Review and Trade Terms Quiz. Alternatively, these may be assigned as homework at the end of Session Thirty-Nine. Go over the Module Review in class prior to the exam and answer any questions that the trainees may have.

1. Have trainees complete the written examination. Any outstanding performance testing must be completed during this session as well.
2. Record the testing results on the Registration of Training Module form, and submit the report to your Training Program Sponsor.
## Equipment and Materials

<table>
<thead>
<tr>
<th>Personal protective equipment:</th>
<th>Angle and/or die grinders</th>
<th>Grinding wheels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate flame-retardant clothing</td>
<td>Welding equipment suitable for SMAW welding operations</td>
<td>Welding benches with arm for position work</td>
</tr>
<tr>
<td>Safety glasses</td>
<td>Cutting equipment (appropriate saws or oxyfuel cutting equipment)</td>
<td>Tape measure or steel rules</td>
</tr>
<tr>
<td>Welding shield or helmet</td>
<td>Squares</td>
<td>Files</td>
</tr>
<tr>
<td>Properly-tinted goggles or face shields</td>
<td>Wire brushes</td>
<td>Soapstone</td>
</tr>
<tr>
<td>Work gloves</td>
<td>Chipping hammer</td>
<td>Common hand tools</td>
</tr>
<tr>
<td>Welding gloves</td>
<td>¼” to ¾” thick mild steel plate (6 to 20 mm metric plate)</td>
<td>½” angle iron sections (5 mm metric)</td>
</tr>
<tr>
<td>Proper footwear as designated by the instructor or training facility provider</td>
<td>Electrode types E6010 or E6011, and E7018</td>
<td></td>
</tr>
<tr>
<td>Hearing protection as designated by the instructor or training facility provider</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard hat as designated by the instructor or training facility provider</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Markers/chalk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pencils and paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Welding Level One PowerPoint® Presentation Slides</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DVD player</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copies of the Module Examination and Performance Profile Sheets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review Question and Trade Terms Quiz answer keys</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module Ten (29110-15) introduces the trainees to the techniques and procedures to perform proper joint fit-up and inspection. Trainees will become familiar with using codes, specifications, special tools, and measuring devices to ensure quality during welding.

Objectives

Learning Objective 1
• Identify and describe various types of fit-up and alignment tools.
  a. Identify and describe various fit-up gauges and measuring devices.
  b. Identify and describe common weldment positioning equipment.
  c. Identify and describe various plate alignment tools.
  d. Identify and describe various pipe and flange alignment tools.

Learning Objective 2
• Describe techniques to avoid weldment distortion and describe the role of codes and specifications.
  a. Describe the causes of weldment distortion.
  b. Describe the techniques and tools used to control weldment distortion.
  c. Describe the role of codes and specifications in welding procedures and techniques.

Performance Tasks

Performance Task 1
(Learning Objectives 1 and 2)
• Fit up joints using plate and pipe fit-up tools.

Performance Task 2
(Learning Objectives 1 and 2)
• Check the joint for proper fit-up and alignment using gauges and measuring devices.

Teaching Time: 7.5 hours
(Three 2.5-Hour Classroom Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Prerequisites
Core Curriculum; Welding Level One, Module 29101-15.

Before You Begin
As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider the time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from www.nccerirc.com. The passing score for submission into NCCER’s Registry is 70% or above for the written examination; performance testing is graded pass or fail.
Safety Considerations
Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to hazards related to the welding environment. Although no welding tasks are associated with this module, the trainees will likely be in the vicinity of welding operations and related equipment. Any deficiencies in safety practices must be corrected to ensure future trainee safety.

Classroom Equipment and Materials
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- Welding Level One PowerPoint® Presentation
- DVD player or a computer with a DVD drive
- LCD projector and screen
- Computer with internet access
- Module Review and Trade Terms
- Quiz answer keys
- Copies of the Module Examination and Performance Profile sheets
- Examples and/or excerpts from various welding codes

Equipment and Materials for Laboratories and Performance Testing
- Appropriate PPE:
  - Safety glasses
  - Face shields (with proper tint if oxyfuel cutting will be performed)
  - Work gloves
  - Proper footwear as designated by the instructor or training facility provider
  - Hearing protection as designated by the instructor or training facility provider
  - Hard hat as designated by the instructor or training facility provider
- Angle grinders
- Bench grinders
- Grinding wheels
- Plate and pipe cutting equipment (saws or oxyfuel cutting equipment)
- Plate alignment tools
- Combination square
- Pipefitter’s square
- Levels
- Straight edges
- Files
- Hi-Lo gauge
- Pipe pullers
- Wedges
- Small-diameter pipe clamping devices
- Chain clamps, cage clamps, rim clamps, and/or other pipe and fitting clamping devices
- Flange alignment tools
- Carbon steel plate and pipe of various sizes

Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study:


There are a number of online resources available for trainees who would like more information on joint fit-up and alignment tools. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss the correct conduct and techniques.

There are also numerous videos available on the internet related to joint fit-up. These can be located by using various relevant search terms, and then using the Video tab on the results page of your preferred search engine.

Instructors are also encouraged to locate additional audiovisual aids available on the internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.
The Lesson Plan for this module is divided into three 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

**Session One**

Session One introduces the trainees to the identification of various fit-up alignment tools, measuring devices, positioning equipment, and techniques to reduce weldment distortion. Trainees will also learn the role of codes, standards, and specifications. This session covers Sections 1.0.0 through 2.3.3.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and give them an idea of what they will learn from this module.
3. Describe fit-up gauges.
4. Describe common weldment positioning equipment.
5. Describe various plate, pipe, and flange alignment tools.
6. Present techniques and tools to control weldment distortion.
7. Describe the role of codes and specifications.
8. Present welding techniques and procedures.

**Session Two**

Session Two is a laboratory session devoted to the completion of Performance Tasks 1 and 2.

1. Note that no PowerPoint® presentation is associated with this laboratory session.
2. Demonstrate to the trainees how to fit-up joints using plate and pipe fit-up tools.
3. Demonstrate how to check for proper joint fit-up and alignment using gauges and measuring devices.
4. Trainees practice and complete Performance Tasks 1 and 2.

**Session Three**

Session Three is a review and testing session. Have trainees complete the Module Review and Trade Terms Quiz. Alternatively, these may have been assigned as homework at the end of the previous session. Go over the Module Review in class prior to the exam and answer any questions that the trainees may have.

1. Have trainees complete the written examination. Any outstanding performance testing must be completed during this session as well.
2. Record the testing results on the Registration of Training Modules form, and submit the report to your Training Program Sponsor.
# Materials Checklist for Module 29110-15, Joint Fit-Up and Alignment

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th>Personal protective equipment: Examples and/or excerpts from various welding codes</th>
<th>Angle grinders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Safety glasses</td>
<td>Bench grinders</td>
</tr>
<tr>
<td></td>
<td>Safety glasses</td>
<td>Grinding wheels</td>
</tr>
<tr>
<td></td>
<td>Face shields (with proper tint if oxyfuel cutting will be performed)</td>
<td>Plate and pipe cutting equipment (saws or oxyfuel cutting equipment)</td>
</tr>
<tr>
<td></td>
<td>Work gloves</td>
<td>Plate alignment tools</td>
</tr>
<tr>
<td></td>
<td>Work gloves</td>
<td>Pipefitter’s square</td>
</tr>
<tr>
<td></td>
<td>Proper footwear as designated by the instructor or training facility provider</td>
<td>Combination square</td>
</tr>
<tr>
<td></td>
<td>Hearing protection as designated by the instructor or training facility provider</td>
<td>Levels</td>
</tr>
<tr>
<td></td>
<td>Hearing protection as designated by the instructor or training facility provider</td>
<td>Files</td>
</tr>
<tr>
<td></td>
<td>Hard hat as designated by the instructor or training facility provider</td>
<td>Pipe pullers</td>
</tr>
<tr>
<td></td>
<td>Whiteboard/chalkboard</td>
<td>Wedges</td>
</tr>
<tr>
<td></td>
<td>Markers/chalk</td>
<td>Chain clamps, cage clamps, rim clamps, and/or other pipe and fitting clamping devices</td>
</tr>
<tr>
<td></td>
<td>Pencils and paper</td>
<td>Carbon steel plate and pipe of various sizes</td>
</tr>
<tr>
<td></td>
<td><em>Welding Level One</em> PowerPoint® Presentation Slides</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DVD player</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Computer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Copies of the Module Examination and Performance Profile sheets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Module Review and Trade Terms Quiz answer keys</td>
<td></td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module Eleven (29111-15) introduces the trainees to the method and procedures related to the SMAW groove welding process. Trainees will learn safety procedures, welding joint preparation, specifications, identification of physical characteristics, mechanical properties, and cleaning techniques of SMAW groove welds.

Objectives

**Learning Objective 1**
- Identify various types of groove welds and describe how to prepare for groove welding.
  a. Identify various types of groove welds and define related terms.
  b. Describe how to prepare for groove welding.

**Learning Objective 2**
- Describe the technique required to produce various groove welds.
  a. Describe the technique required to produce groove welds in the 1G and 2G positions.
  b. Describe the technique required to produce groove welds in the 3G and 4G positions.

Performance Tasks

**Performance Task 1 (Learning Objective 1)**
- Safely set up arc welding equipment for making groove welds.

**Performance Task 2 (Learning Objective 2)**
- Make flat welds with backing on V-groove joints using E7018 electrodes.

**Performance Task 3 (Learning Objective 2)**
- Make horizontal welds with backing on V-groove joints using E7018 electrodes.

**Performance Task 4 (Learning Objective 2)**
- Make vertical welds with backing on V-groove joints using E7018 electrodes.

**Performance Task 5 (Learning Objective 2)**
- Make overhead welds with backing on V-groove joints using E7018 electrodes.

Teaching Time: 50 hours
(Twenty 2.5-Hour Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Prerequisites

*Core Curriculum; Welding Level One, Module 29101-15.*

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER's Registry is 70% or above for the written examination; performance testing is graded pass or fail.
**Safety Considerations**

This module requires that trainees work with equipment that can generate high currents and extreme heat. Safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to unseen hazards related to base metal preparation. Any deficiencies must be corrected to ensure future trainee safety. All practice sessions and performance tasks must be completed under your direct supervision.

---

**Classroom Equipment and Materials**

- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Welding Level One* PowerPoint® presentations
- DVD player or a computer with a DVD drive
- LCD projector and screen
- Computer with internet access
- Module Review answer key
- Copies of the Module Examination and Performance Profile Sheets

---

**Equipment and Materials for Laboratories and Performance Testing**

- Appropriate PPE:
  - Appropriate flame-retardant clothing
  - Safety glasses
  - Welding gloves
  - Welding shield or helmet
  - Other welding PPE required for welding in all four positions
  - Proper footwear as directed by the instructor or training facility provider
  - Hearing protection as directed by the instructor or training facility provider
  - Hard hat as directed by the instructor or training facility provider
  - Welding equipment suitable for SMAW operations
  - Electrodes, E7018

---

**Additional Resources**

This module presents thorough resources for task training. The following resource material is suggested for further study.

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


There are a number of online resources available for trainees who would like more information on SMAW groove welding. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques. Below are examples of relevant videos available online. Many other videos can be located online using search terms such as “groove welding” or “welding with backing”.


Instructors are encouraged to locate additional audiovisual aids available on the internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.
Session Outline for 29111-15

SMAW – GROOVE WELDS WITH BACKING

The Lesson Plan for this module is divided into twenty 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

**Session One**

Session One introduces trainees to SMAW groove welding, including techniques used to complete V-groove welds with backing and welding techniques used in different positions. This session covers Sections 1.0.0 through 2.2.2.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and give them an idea of what they will learn from this module.
3. Explain that safety must be maintained and appropriate protective clothing and equipment must be worn.
4. Describe the types of SMAW groove welds with backing and discuss related terminology.
5. Explain how to set up SMAW welding equipment and prepare welding coupons for groove welding.
6. Describe how SMAW groove welding in the various positions.

**Sessions Two through Nineteen**

Sessions Two through Nineteen are laboratory sessions for practice and completion of the performance tasks related to performing groove welds in the 1G, 2G, 3G, and 4G positions.

1. Note that no PowerPoint® presentation is associated with this laboratory session.
2. Review safety procedures and make sure that all trainees are wearing the required PPE.
5. Trainees complete the requirements of Performance Task 1.

**Session Twenty**

Session Twenty is a review and testing session. Have trainees complete the Module Review Questions. Alternatively, these may be assigned as homework at the end of Session Nineteen. Go over the answers to the Module Review in class prior to the exam and answer any questions that the trainees may have.

1. Have trainees complete the written examination. Any outstanding performance testing must be completed during this session as well.
2. Record the testing results on the Registration of Training Modules form, and submit the report to your Training Program Sponsor.
### Materials Checklist for Module 29111-15, SMAW – Groove Welds with Backing

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th>Equipment and Materials</th>
<th>Equipment and Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal protective equipment:</strong></td>
<td>Welding equipment suitable for SMAW operations</td>
<td>Electrodes, E7018</td>
</tr>
<tr>
<td>Appropriate flame-retardant clothing</td>
<td>Sufficient supply of carbon steel for practice backing, ⅛”-thick minimum</td>
<td>Sufficient supply of carbon steel for practice coupons, ⅛”-thick minimum</td>
</tr>
<tr>
<td>Safety glasses</td>
<td>Cutting equipment (appropriate saw, shear, or oxyfuel equipment)</td>
<td>Angle grinders</td>
</tr>
<tr>
<td>Welding gloves</td>
<td>Welding bench with arm for position work</td>
<td>Files</td>
</tr>
<tr>
<td>Welding shield or helmet</td>
<td>Tape measure or steel rules</td>
<td>Squares</td>
</tr>
<tr>
<td>Other welding PPE required for welding in all four positions</td>
<td>Wire brushes</td>
<td>Chipping hammer</td>
</tr>
<tr>
<td>Proper footwear as directed by the instructor or training facility provider</td>
<td>Shop hand tools</td>
<td>Workpiece clamps</td>
</tr>
<tr>
<td>Hearing protection as directed by the instructor or training facility provider</td>
<td>Grinding wheels</td>
<td>Soapstone</td>
</tr>
<tr>
<td>Hard hat as directed by the instructor or training facility provider</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Whiteboard/chalkboard | | |
| Markers/chalk | | |
| Pencils and paper | | |
| *Welding Level One* PowerPoint® presentations | | |
| DVD player | | |
| Computer | | |
| Copies of the Module Examination and Performance Profile Sheets | | |
| Module Review answer key | | |

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module Twelve (29112-15) introduces trainees to the methods and procedures of the SMAW open-root groove welding process. Trainees will learn about safety procedures and groove joint preparation, and practice open-root groove welding techniques.

### Objectives

**Learning Objective 1**
- Identify various types of groove welds and describe how to prepare for groove welding.
  - a. Identify various types of groove welds and define related terms.
  - b. Describe how to prepare the work area and plate for groove welding.

**Learning Objective 2**
- Describe the technique required to produce various open V-groove welds.
  - a. Describe the technique required to produce open V-groove welds in the 1G and 2G positions.
  - b. Describe the technique required to produce open V-groove welds in the 3G and 4G positions.

### Performance Tasks

**Performance Task 1**
- 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

### Teaching Time: 60 hours

(Twenty-Four 2.5-Hour Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

### Prerequisites

*Core Curriculum; Welding Level One, Module 29101-15.*

### Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER's Registry is 70% or above for the written examination; performance testing is graded pass or fail.
**Safety Considerations**
This module requires that trainees work with equipment that can generate high currents and extreme heat. Safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to unseen hazards related to open-root groove welding. Any deficiencies must be corrected to ensure future trainee safety. All practice sessions and performance tasks must be completed under your direct supervision.

**Classroom Equipment and Materials**
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Welding Level One* PowerPoint® Presentation
- DVD player or a computer with a DVD drive
- LCD projector and screen
- Computer with internet access
- Module Review and Trade Terms
- Quiz answer keys
- Copies of the Module Examination and Performance Profile sheets

**Equipment and Materials for Laboratories and Performance Testing**
- Appropriate PPE:
  - Appropriate flame-retardant clothing
  - Safety glasses
  - Face shields (tinted if used for oxyfuel cutting)
  - Welding gloves
  - Work gloves
  - Welding shield or hood
  - Proper footwear as directed by the instructor or training facility provider
  - Hearing protection as directed by the instructor or training facility provider
  - Hard hat as directed by the instructor or training facility provider
  - Sufficient E6010 and E7018 electrodes
- SMAW equipment, complete with electrode holders, workpiece clamps, and cables
- Sufficient supply of carbon steel for practice, \( \frac{1}{4}'' \) (9 or 10 mm) thick minimum
- Welding bench with arm for position work
- Metal cutting equipment (saw or oxyfuel equipment)
- Angle grinders
- Grinding wheels
- Squares
- Tape measures or steel rules
- Soapstone
- Files
- Chipping hammer
- Wire brushes
- Common hand tools

**Additional Resources**
This module presents thorough resources for task training. The following resource material is suggested for further study.


There are a number of online resources available for trainees who would like more information on SMAW open-root groove welding. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Instructors are also encouraged to locate additional audiovisual aids available on the internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.
The Lesson Plan for this module is divided into twenty-four 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

### Session One

Session One introduces trainees to SMAW open-root groove welding on plate. Standard safety practices are reviewed, along with guidance in the proper preparation of the weld coupons and work area. This session covers Sections 1.0.0 through 2.2.2.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and give them an idea of what they will learn from this module.
3. Review the various types of groove joints and their details.
4. Review the common safety practices associated with welding.
5. Discuss the electrodes to be used for groove welding.
6. Explain how to properly prepare the work area for welding.
7. Describe the techniques used in SMAW groove welding and the differences in technique required for each position.

### Sessions Two Through Twenty-Three

Sessions Two through Twenty-Three are laboratory sessions dedicated to the practice and completion of Performance Task 1.

1. Note that no PowerPoint® presentation is associated with this laboratory session.
2. Demonstrate how to safely perform the required tasks using SMAW equipment.
3. Describe preparation of welding coupon and welding of V-groove joints using E6010 or E7018 electrodes.
4. Demonstrate open-root groove welding in the various positions.
5. Trainees practice and complete Performance Task 1.

### Session Twenty-Four

Session Twenty-Four is a review and testing session. Have trainees complete the Module Review and Trade Terms Quiz. Alternatively, these may have been assigned as homework at the end of Session Twenty-Three. Go over the Module Review and Trade Terms Quiz in class prior to the exam and answer any questions that the trainees may have.

1. Have trainees complete the written examination. Any outstanding performance testing must be completed during this session as well.
2. Record the testing results on the Registration of Training Modules form, and submit the report to your Training Program Sponsor.
# Materials Checklist for Module 29112-15, SMAW – Open-Root Groove Welds – Plate

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal protective equipment:</strong></td>
<td>SMAW equipment, complete with electrode holders, workpiece clamps, and cables</td>
</tr>
<tr>
<td>Appropriate flame-retardant clothing</td>
<td>Welding bench with arm for position work</td>
</tr>
<tr>
<td>Safety glasses</td>
<td>Angle grinders</td>
</tr>
<tr>
<td>Face shields (tinted if used for oxyfuel cutting)</td>
<td>Squares</td>
</tr>
<tr>
<td>Welding gloves</td>
<td>Soapstone</td>
</tr>
<tr>
<td>Work gloves</td>
<td>Chipping hammer</td>
</tr>
<tr>
<td><strong>Welding shield or hood</strong></td>
<td>Common hand tools</td>
</tr>
<tr>
<td>Proper footwear as directed by the instructor or training facility provider</td>
<td></td>
</tr>
<tr>
<td>Hearing protection as directed by the instructor or training facility provider</td>
<td></td>
</tr>
<tr>
<td><strong>Hard hat as directed by the instructor or training facility provider</strong></td>
<td></td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td></td>
</tr>
<tr>
<td>Markers/chalk</td>
<td></td>
</tr>
<tr>
<td>Pencils and paper</td>
<td></td>
</tr>
<tr>
<td><em>Welding Level One</em> PowerPoint® Presentation</td>
<td></td>
</tr>
<tr>
<td>DVD player</td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td></td>
</tr>
<tr>
<td>Copies of the Module Examination and Performance Profile sheets</td>
<td></td>
</tr>
<tr>
<td>Module Review and Trade Terms Quiz Answer Keys</td>
<td></td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.