

SMAW OPEN-ROOT PIPE WELDS

Module One (29301) presents shielded metal arc welding (SMAW) of open-root pipe joints. SMAW is a well-established form of welding used extensively in commercial and industrial applications around the world. One routine use of SMAW is for joining pipe of various thicknesses and diameters. The most common joint used for these applications is the open-root V-groove joint. This module describes how to prepare and perform open-root V-groove welds on pipe in all positions using SMAW equipment and electrodes.

Objectives

Learning Objective 1

- State the basic concepts of open-root SMAW and how to prepare for welding.
 - a. State the basic concepts of open-root SMAW of pipe.
 - b. Identify common welding safety practices.
 - c. Explain how to prepare the area, materials, and equipment for SMAW of pipe.

Learning Objective 2

- Describe open-root pipe welding positions and related SMAW techniques.
 - a. Identify and describe the four pipe welding positions and acceptable weld profiles.
 - b. Describe the SMAW techniques for root and fill passes on pipe.
 - c. Describe the techniques required to produce open-root SMAW pipe welds in all positions.

Performance Tasks

Performance Task 1

(Learning Objective 2)

- Make open-root pipe welds in the 1G-ROTATED position.

Performance Task 2

(Learning Objective 2)

- Make open-root pipe welds in the 2G position.

Performance Task 3

(Learning Objective 2)

- Make open-root pipe welds in the 5G position.

Performance Task 4

(Learning Objective 2)

- Make open-root pipe welds in the 6G position.

Teaching Time: 100 hours

(Forty 2.5-Hour Sessions)

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

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 requires that trainees work with and around 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 unseen hazards related to welding and the welding environment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

Classroom Equipment and Materials

Whiteboard
Dry-erase markers
A variety of standard marker sizes
Pencils and paper
Poster board
Flip chart
Welding Level Three PowerPoint® Presentation
LCD projector and screen
Computer (Internet access optional)
Module Review answer key
Copies of the Module Examination and Answer Key (for paper-based exams)
Performance Profile sheets

Equipment and Materials for Laboratories and Performance Testing

Minimum safety equipment:
Appropriate flame-retardant clothing
Safety glasses
Face shields
Work gloves
Welding gloves
Welding hood with a lens of the appropriate shade
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 machines compatible with SMAW and capable of DC welding, complete with electrode holders, workpiece clamps, and cables

Sufficient supply of carbon-steel pipe for practice, 3" to 12" (DN80 to DN300) Schedule 40 or Schedule 80 pipe
Welding bench with arm suited for position work; alternatively, a welding positioner may be used
Sufficient supply of E6010 and E7018 electrodes
Metal cutting equipment (mechanical or thermal)
Angle grinders
Grinding wheels
Squares
Tape measures or steel rules
Soapstone
Files
Chipping hammers
Wire brushes
Common hand tools

Additional Resources

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

AWS F4.1: Recommended Safe Practices for Preparation for Welding and Cutting of Containers and Piping. Miami, FL: American Welding Society.

Modern Welding Technology. Current Edition. Howard B. Cary and Scott Helzer. Englewood Cliffs, NJ: Prentice Hall.

OSHA 1926.351, Arc Welding and Cutting. Current Edition. Washington, DC: Occupational Safety & Health Administration.

The Procedure Handbook of Arc Welding. Current Edition. Cleveland, OH: The James F. Lincoln Arc Welding Foundation.

Welding Handbook, Volumes 1 through 4. Current Edition. Miami, FL: American Welding Society.

Welding Pressure Pipelines and Piping Systems (PDF). The Lincoln Electric Company, Cleveland, OH, USA. <http://www.lincolnelectric.com>. Last accessed May 29, 2015.

There are a number of online resources available for trainees who would like more information on open-root pipe welding using the SMAW process. 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.

Numerous videos related to the topic are available on the Internet. These can be located by searching "SMAW pipe welding" or similar terms, and using the Video tab on the results page of your preferred search engine.

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 presentations throughout the program.



SMAW OPEN-ROOT PIPE WELDS

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 provides information on welding safety practices and the required preparations for SMAW pipe welding. This session covers Section 1.0.0.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to refresh trainees' memories about the SMAW process.
3. Review common welding safety practices, emphasizing any SMAW-specific safety issues.
4. Describe how to prepare the welding area, welding coupons, and the welding equipment.
5. Identify the four primary pipe-welding positions.
6. Review the characteristics of an acceptable weld profile.
7. Use the Section Review questions to review the topics of this session.

SESSION TWO

Session Two describes the techniques used to produce SMAW open-root V-groove pipe welds. This session covers Section 2.0.0. Trainees will also complete the Module Review questions and the Module Examination during this session.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to review multiple-inclined position 6G SMAW techniques using a video.

3. Review the techniques required to apply the root pass.
4. Describe the electrodes and techniques required for the remaining passes.
5. Discuss the details related to each pipe-welding position.
6. Use the Section Review questions to review the topics of this session.
7. Go over the Module Review questions to prepare trainees for the Module Exam.
8. Administer the module exam. Record the testing results on the Registration of Training Modules form and submit the form to your Training Program Sponsor.

SESSIONS THREE THROUGH FORTY

Sessions Three through Forty are laboratory sessions that provide trainees with an opportunity to practice and complete the Performance Tasks associated with this module.

1. Note that no slide presentation is associated with these laboratory sessions.
2. Demonstrate how to complete SMAW open-root V-groove pipe welds on pipe coupons.
3. Have trainees practice and complete the requirements of Performance Tasks 1 through 4.
4. Document successful Performance Task completions for each trainee on the Performance Profile sheet and submit the results to the Training Program Sponsor.



Materials Checklist for Module 29301, SMAW Open-Root Pipe Welds

Equipment and Materials				
Personal protective equipment:		Squares		
Appropriate flame-retardant clothing		Tape measures or steel rules		
Safety glasses		Soapstone		
Face shields		Sufficient supply of E6010 and E7018 electrodes		
Work gloves		Metal cutting equipment (mechanical or thermal)		
Welding gloves		Angle grinders		
Welding hood with a lens of the appropriate shade		Grinding wheels		
Proper footwear as directed by the instructor or training facility provider		Welding machines compatible with SMAW and capable of DC welding, complete with electrode holders, workpiece clamps, and cables		
Hearing protection as directed by the instructor or training facility provider		Sufficient supply of carbon-steel pipe for practice, 3" to 12" (DN80 to DN300) Schedule 40 or Schedule 80 pipe		
Hard hat as directed by the instructor or training facility provider		Welding bench with arm suited for position work; alternatively, a welding positioner may be used		
Whiteboard		Files		
Dry-erase markers		Chipping hammers		
A variety of standard marker sizes		Wire brushes		
Pencils and paper		Common hand tools		
Poster board				
Flip chart				
<i>Welding Level Three</i> PowerPoint® Presentation				
LCD projector and screen				
Computer (Internet access optional)				
Module Review answer key				
Copies of the Module Examination and answer key				
Performance Profile Sheets				

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.



Lesson Plans for Module 29302

GMAW – PIPE

Module Two (29302) presents gas metal arc welding (GMAW)—a form of welding that joins two metals together using a filler metal wire electrode and a shielding gas. GMAW is an effective method for making high-quality, open-root V-groove welds on pipe. This module covers some basic concepts of open-root GMAW of pipe and describes how to prepare and perform open-root V-groove welds on medium- and thick-walled pipe in all positions.

Objectives

Learning Objective 1

- State the basic concepts of open-root GMAW of pipe and how to prepare for welding.
 - a. State the basic concepts of GMAW.
 - b. Identify common welding safety practices.
 - c. Explain how to prepare the area and materials for GMAW pipe welding.
 - d. Explain how to prepare the equipment for GMAW pipe welding.

Learning Objective 2

- Describe open-root V-groove pipe welding positions and GMAW techniques.
 - a. Identify and describe the four pipe welding positions and acceptable weld profiles.
 - b. Describe the technique for GMAW of the root and fill passes.
 - c. Describe the techniques required to produce open-root GMAW pipe welds in all positions.

Performance Tasks

Performance Task 1

(Learning Objective 2)

- Make GMAW open-root V-groove pipe welds in the 1G-ROTATED position using the correct filler metal and shielding gas.

Performance Task 2

(Learning Objective 2)

- Make GMAW open-root V-groove pipe welds in the 2G position using the correct filler metal and shielding gas.

Performance Task 3

(Learning Objective 2)

- Make GMAW open-root V-groove pipe welds in the 5G position using the correct filler metal and shielding gas.

Performance Task 4

(Learning Objective 2)

- Make GMAW open-root V-groove pipe welds in the 6G position using the correct filler metal and shielding gas.

Teaching Time: 60 hours

(Twenty-Four 2.5-Hour Sessions)

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

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 requires that trainees work with and around equipment that generates high voltages, extremely high temperatures, and intense ultraviolet radiation. Trainees must also handle shielding gases under high pressure. 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 welding and the welding environment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

Classroom Equipment and Materials

Whiteboard
Dry-erase markers
A variety of standard marker sizes
Pencils and paper
Poster board
Flip chart
Welding Level Three PowerPoint® Presentation
LCD projector and screen
Computer (Internet access optional)
Module Review answer key
Copies of the Module Examination and Answer Key (for paper-based exams)
Performance Profile sheets

Equipment and Materials for Laboratories and Performance Testing

Minimum safety equipment:
Appropriate flame-retardant clothing
Safety glasses
Face shields
Work gloves
Welding gloves
Welding hood with a lens of the appropriate shade
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 machines capable of GMAW, complete with welding guns, cables, and shielding gas hoses
Wire feeders
Sufficient supply of appropriate electrode wire

Sufficient supply of shielding gas
Sufficient supply of carbon-steel pipe for practice, 3" to 12" (DN80 to DN300) Schedule 40 or Schedule 80 pipe
Welding bench with arm suited for position work; alternatively, a welding positioner may be used
Metal cutting equipment (mechanical or thermal)
Angle grinders
Grinding wheels
Squares
Tape measures or steel rules
Soapstone
Files
Chipping hammers
Wire brushes
Common hand tools

Additional Resources

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

AWS F4.1: Recommended Safe Practices for Preparation for Welding and Cutting of Containers and Piping. Miami, FL: American Welding Society.

Modern Welding Technology. Current Edition. Howard B. Cary and Scott Helzer. Englewood Cliffs, NJ: Prentice Hall.

OSHA 1926.351, Arc Welding and Cutting. Current Edition. Washington, DC: Occupational Safety & Health Administration.

The Procedure Handbook of Arc Welding. Current Edition. Cleveland, OH: The James F. Lincoln Arc Welding Foundation.

Welding Handbook, Volumes 1 through 4. Current Edition. Miami, FL: American Welding Society.

Welding Pressure Pipelines and Piping Systems (PDF). The Lincoln Electric Company, Cleveland, OH, USA. <http://www.lincolnelectric.com>. Last accessed May 29, 2015.

Gas Metal Arc Welding – Product and Procedures Selection (PDF). The Lincoln Electric Company, Cleveland, OH, USA. <http://www.lincolnelectric.com>. Last accessed May 29, 2015.

There are a number of online resources available for trainees who would like more information on open-root pipe welding using the GMAW process. 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. Numerous videos related to the topic are available on the Internet. These can be located by searching “GMAW pipe welding” or similar terms, and using the Video tab on the results page of your preferred search engine. 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 presentations throughout the program.



Session Outline for 29302

GMAW – PIPE

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 provides information on welding safety practices and the required preparations for GMAW pipe welding. This session covers Section 1.0.0.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to review Lincoln Electric's STT approach to GMAW welding.
3. Review the basic concepts of GMAW pipe welding.
4. Review common welding safety practices, emphasizing any GMAW-specific safety issues.
5. Describe how to prepare the welding area, welding coupons, and the welding equipment.
6. Use the Section Review questions to review the topics of this session.
3. Review the primary pipe-welding positions and acceptable and unacceptable weld profiles.
4. Review the techniques required to apply the root pass and techniques required for the remaining passes.
5. Discuss the details related to each pipe-welding position.
6. Use the Section Review questions to review the topics of this session.
7. Go over the Module Review questions to prepare trainees for the Module Exam.
8. Administer the module exam. Record the testing results on the Registration of Training Modules form and submit the form to your Training Program Sponsor.

SESSION TWO

Session Two describes the techniques used to produce GMAW open-root V-groove pipe welds. This session covers Section 2.0.0. Trainees will also complete the Module Review questions and the Module Examination during this session.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to review the application of a GMAW root pass on pipe in the 1G-ROTATED position.

SESSIONS THREE – TWENTY-FOUR

Sessions Three through Twenty-Four are laboratory sessions that provide trainees with an opportunity to practice and complete the Performance Tasks associated with this module.

1. Note that no slide presentation is associated with these laboratory sessions.
2. Demonstrate how to complete GMAW open-root V-groove pipe welds on pipe coupons.
3. Have trainees practice and complete the requirements of Performance Tasks 1 through 4.
4. Document successful Performance Task completions for each trainee on the Performance Profile sheet and submit the results to the Training Program Sponsor.



Materials Checklist for Module 29302, GMAW – Pipe

Equipment and Materials				
Personal protective equipment:		Squares		
Appropriate flame-retardant clothing		Metal cutting equipment (mechanical or thermal)		
Safety glasses		Wire feeders		
Face shields		Sufficient supply of electrode wire		
Work gloves		Sufficient supply of shielding gas		
Welding gloves		Angle grinders		
Welding hood with a lens of the appropriate shade		Grinding wheels		
Proper footwear as directed by the instructor or training facility provider		Welding machines capable of GMAW, complete with welding guns, cables, and shielding gas hoses		
Hearing protection as directed by the instructor or training facility provider		Sufficient supply of carbon-steel pipe for practice, 3" to 12" (DN80 to DN300) Schedule 40 or Schedule 80 pipe		
Hard hat as directed by the instructor or training facility provider		Welding bench with arm suited for position work; alternatively, a welding positioner may be used		
Whiteboard		Files		
Dry-erase markers		Chipping hammers		
A variety of standard marker sizes		Wire brushes		
Pencils and paper		Common hand tools		
Poster board		Soapstone		
Flip chart		Tape measures or steel rules		
<i>Welding Level Three</i> PowerPoint® Presentation				
LCD projector and screen				
Computer (Internet access optional)				
Module Review answer key				
Copies of the Module Examination and answer key				
Performance Profile Sheets				

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.



Lesson Plans for Module 29303

FCAW – PIPE

Module Three (29303) presents the flux-core arc welding (FCAW) process. It is excellent for pipe welding, although the root pass is seldom applied using FCAW. FCAW is a versatile process that can be done with or without a shielding gas, depending upon the wire electrode used. This module describes the two primary approaches to FCAW and provides guidance to practice the techniques.

Objectives

Learning Objective 1

- State the basic concepts of FCAW of pipe and how to prepare for welding.
 - a. State the basic concepts of FCAW.
 - b. Identify common welding safety practices.
 - c. Explain how to prepare the area and materials for FCAW pipe welding.
 - d. Explain how to prepare the equipment for FCAW pipe welding.

Learning Objective 2

- Describe V-groove pipe welding positions and FCAW techniques.
 - a. Identify and describe the four pipe welding positions and acceptable weld profiles.
 - b. Describe the technique for FCAW of the root and fill passes.
 - c. Describe the techniques required to produce FCAW pipe welds in all positions.

Performance Tasks

Performance Task 1

(Learning Objective 2)

- Make FCAW open-root V-groove pipe welds in the 1G-ROTATED position.

Performance Task 2

(Learning Objective 2)

- Make FCAW open-root V-groove pipe welds in the 2G position.

Performance Task 3

(Learning Objective 2)

- Make FCAW open-root V-groove pipe welds in the 5G position.

Performance Task 4

(Learning Objective 2)

- Make FCAW open-root V-groove pipe welds in the 6G 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.

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 requires that trainees work with and around 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 unseen hazards related to welding and the welding environment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

Classroom Equipment and Materials

Whiteboard
Dry-erase markers
A variety of standard marker sizes
Pencils and paper
Poster board
Flip chart
Welding Level Three PowerPoint® Presentation
LCD projector and screen
Computer (Internet access optional)
Module Review answer key
Copies of the Module Examination and Answer Key (for paper-based exams)
Performance Profile sheets

Equipment and Materials for Laboratories and Performance Testing

Minimum safety equipment:
Appropriate flame-retardant clothing
Safety glasses
Face shields
Work gloves
Welding gloves
Welding hood with a lens of the appropriate shade
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 machines capable of FCAW and GMAW, complete with welding guns, cables, and shielding gas hoses. If root passes are to be done with SMAW, the appropriate equipment and E6010 electrodes for that process will also be required.
Wire feeders

Sufficient supply of appropriate electrode wire
Sufficient supply of shielding gas (instructor option)
Sufficient supply of carbon-steel pipe for practice, 3" to 12" (DN80 to DN300) Schedule 40 or Schedule 80 pipe
Welding bench with arm suited for position work; alternatively, a welding positioner may be used
Metal cutting equipment (mechanical or thermal)
Angle grinders
Grinding wheels
Squares
Tape measures or steel rules
Soapstone
Files
Chipping hammers
Wire brushes
Common hand tools

Additional Resources

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

AWS F4.1: Recommended Safe Practices for Preparation for Welding and Cutting of Containers and Piping. Miami, FL: American Welding Society.

Modern Welding Technology. Current Edition. Howard B. Cary and Scott Helzer. Englewood Cliffs, NJ: Prentice Hall.

OSHA 1926.351, Arc Welding and Cutting. Current Edition. Washington, DC: Occupational Safety & Health Administration.

The Procedure Handbook of Arc Welding. Current Edition. Cleveland, OH: The James F. Lincoln Arc Welding Foundation.

Welding Handbook, Volumes 1 through 4. Current Edition. Miami, FL: American Welding Society.

Welding Pressure Pipelines and Piping Systems (PDF). The Lincoln Electric Company, Cleveland, OH, USA. <http://www.lincolnelectric.com>. Last accessed May 29, 2015.

There are a number of online resources available for trainees who would like more information on pipe welding using the FCAW process. 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.

Numerous videos related to the topic are available on the Internet. These can be located by searching "FCAW pipe welding" or similar terms, and using the Video tab on the results page of your preferred search engine.

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 presentations throughout the program.



Session Outline for 29303

FCAW – PIPE

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 welding safety practices and the required preparations for FCAW pipe welding. This session covers Section 1.0.0.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to provide trainees an opportunity to see FCAW pipe welding in progress and listen to the thoughts of welding professionals as the weld progresses.
3. Review the basic concepts of FCAW pipe welding.
4. Review common welding safety practices, emphasizing any FCAW-specific safety issues.
5. Describe how to prepare the welding area, welding coupons, and the welding equipment.
6. Use the Section Review questions to review the topics of this session.

SESSION TWO

Session Two reviews the techniques needed to produce FCAW open-root V-groove pipe welds. This session covers Sections 2.0.0.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to provide trainees with a greater understanding of the various wire electrode products available to them.
3. Review the primary pipe-welding positions.

4. Discuss acceptable and unacceptable weld profiles.
5. Review the techniques required to apply the root pass, emphasizing that the root pass is done with a different process.
6. Review the techniques required for the remaining passes.
7. Review the details related to each pipe-welding position.
8. Use the Section Review questions to review the topics of this session.
9. Go over the Module Review to prepare trainees for the module exam.
10. Administer the module exam. Record the testing results on the Registration of Training Modules form and submit the form to your Training Program Sponsor.

SESSIONS THREE – TWENTY-FOUR

Sessions Three through Twenty-Four are laboratory sessions that provide trainees with an opportunity to practice and complete the Performance Tasks associated with this module.

1. Note that no slide presentation is associated with these laboratory sessions.
2. Demonstrate how to complete FCAW open-root V-groove pipe welds on pipe coupons.
3. Have trainees practice and complete the requirements of Performance Tasks 1 through 4.
4. Document successful Performance Task completions for each trainee on the Performance Profile sheet and submit the results to the Training Program Sponsor.



Materials Checklist for Module 29303, FCAW – Pipe

Equipment and Materials				
Personal protective equipment:		Squares		
Appropriate flame-retardant clothing		Metal cutting equipment (mechanical or thermal)		
Safety glasses		Wire feeders		
Face shields		Sufficient supply of electrode wire		
Work gloves		Sufficient supply of shielding gas		
Welding gloves		Angle grinders		
Welding hood with a lens of the appropriate shade		Grinding wheels		
Proper footwear as directed by the instructor or training facility provider		Welding machines capable of FCAW and GMAW, complete with welding guns, cables, and shielding gas hoses		
Hearing protection as directed by the instructor or training facility provider		If root passes are to be done with SMAW, the appropriate equipment and E6010 electrodes for that process will also be required.		
Hard hat as directed by the instructor or training facility provider		Sufficient supply of shielding gas (instructor option)		
Whiteboard		Sufficient supply of carbon-steel pipe for practice, 3" to 12" (DN80 to DN300) Schedule 40 or Schedule 80 pipe		
Dry-erase markers		Welding bench with arm suited for position work; alternatively, a welding positioner may be used		
A variety of standard marker sizes		Files		
Pencils and paper		Chipping hammers		
Poster board		Wire brushes		
Flip chart		Common hand tools		
<i>Welding Level Three</i> PowerPoint® Presentation		Soapstone		
LCD projector and screen		Tape measures or steel rules		
Computer (Internet access optional)				
Module Review answer key				
Copies of the Module Examination and answer key				
Performance Profile Sheets				

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.



Lesson Plans for Module 29304

GTAW – CARBON STEEL PIPE

Module Four (29304) presents gas tungsten arc welding (GTAW), a unique welding process that requires the welder to coordinate the use of both hands since the filler metal is fed manually. GTAW can be used on critical piping and may sometimes be used for the root pass on pipe welds when other processes have been directed for the remaining passes. GTAW is also excellent for welding thin materials such as auto bodies. This module provides instruction in the use of GTAW for carbon steel pipe welding, including guided practice.

Objectives

Learning Objective 1

- State the basic concepts of open-root GTAW of carbon-steel pipe and explain how to prepare for welding.
 - a. State the basic concepts of GTAW.
 - b. Identify common welding safety practices.
 - c. Explain how to prepare the area, materials, and equipment for GTAW carbon-steel pipe welding.

Learning Objective 2

- Describe open-root V-groove pipe welding positions and GTAW pipe-welding techniques.
 - a. Identify and describe the four pipe welding positions and acceptable weld profiles.
 - b. Describe the techniques for GTAW and how to make the root and fill passes.
 - c. Describe the techniques required to produce GTAW open-root V-groove carbon-steel pipe welds in all positions.

Performance Tasks

Performance Task 1

(Learning Objective 2)

- Make GTAW open-root V-groove carbon-steel pipe welds in the 1G-ROTATED position using carbon-steel filler metal and argon gas.

Performance Task 2

(Learning Objective 2)

- Make GTAW open-root V-groove carbon-steel pipe welds in the 2G position using carbon-steel filler metal and argon gas.

Performance Task 3

(Learning Objective 2)

- Make GTAW open-root V-groove carbon-steel pipe welds in the 5G position using carbon-steel filler metal and argon gas.

Performance Task 4

(Learning Objective 2)

- Make GTAW open-root V-groove carbon-steel pipe welds in the 6G position using carbon-steel filler metal and argon gas.

Teaching Time: 80 hours

(Thirty-Two 2.5-Hour Sessions)

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

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 requires that trainees work with and around 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 unseen hazards related to welding and the welding environment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

Classroom Equipment and Materials

Whiteboard
Dry-erase markers
A variety of standard marker sizes
Pencils and paper
Poster board
Flip chart
Welding Level Three PowerPoint® Presentation
LCD projector and screen
Computer (Internet access optional)
Module Review answer key
Copies of the Module Examination and Answer Key (for paper-based exams)
Performance Profile sheets

Equipment and Materials for Laboratories and Performance Testing

Minimum safety equipment:
Appropriate flame-retardant clothing
Safety glasses
Face shields
Work gloves
Welding gloves
Welding hood with a lens of the appropriate shade
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
Common hand tools
Welding machines compatible with GTAW, complete with torches, workpiece clamps, shielding gas hoses, and cables
Sufficient volume of shielding gas with regulators/flowmeters
Sufficient supply of filler metal rods for carbon steel
Sufficient supply of carbon-steel pipe for practice, 2" to 6" (DN50 to DN150) Schedule 40 or Schedule 80 pipe
Welding bench with arm suited for position work; alternatively, a welding positioner may be used
Metal cutting equipment (mechanical or thermal)
Angle grinders
Grinding wheels
Squares
Tape measures or steel rules
Soapstone
Files
Chipping hammers
Wire brushes

Additional Resources

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

AWS F4.1: Recommended Safe Practices for Preparation for Welding and Cutting of Containers and Piping. Miami, FL: American Welding Society.

Modern Welding Technology. Current Edition. Howard B. Cary and Scott Helzer. Englewood Cliffs, NJ: Prentice Hall.

OSHA 1926.351, Arc Welding and Cutting. Current Edition. Washington, DC: Occupational Safety & Health Administration.

The Procedure Handbook of Arc Welding. Current Edition. Cleveland, OH: The James F. Lincoln Arc Welding Foundation.

Welding Handbook, Volumes 1 through 4. Current Edition. Miami, FL: American Welding Society.

Welding Pressure Pipelines and Piping Systems (PDF). The Lincoln Electric Company, Cleveland, OH, USA. <http://www.lincolnelectric.com>. Last accessed May 29, 2015.

There are a number of online resources available for trainees who would like more information on open-root pipe welding using the GTAW process. 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.

Numerous videos related to the topic are available on the Internet. These can be located by searching "GTAW pipe welding" or similar terms, and using the Video tab on the results page of your preferred search engine.

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 presentations throughout the program.



Session Outline for 29304

GTAW – CARBON STEEL PIPE

The Lesson Plan for this module is divided into thirty-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 welding safety practices and the required preparations for GTAW pipe welding. This session covers Section 1.0.0.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to expose trainees to the relationships between all primary forms of welding in a unique way.
3. Review the basic concepts of GTAW and how it differs from other processes.
4. Review common welding safety practices, emphasizing any GTAW-specific safety issues.
5. Describe how to prepare the welding area, welding coupons, and the welding equipment.
6. Identify the four primary pipe-welding positions.
7. Review the characteristics of an acceptable weld profile.
8. Use the Section Review questions to review the topics of this session.

SESSION TWO

Session Two reviews the techniques needed to produce GTAW open-root V-groove pipe welds. The module exam is also completed during this session. This session covers Section 2.0.0.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to inform trainees of the many photographic examples of welding available to them through social media sites such as Instagram.

3. Review travel speed, arc length, torch angles, and other important characteristics of the GTAW process.
4. Discuss methods of handling the filler metal rod.
5. Review the techniques required to apply the root pass.
6. Review the techniques required for the hot and remaining passes.
7. Review the details related to each pipe-welding position.
8. Use the Section Review questions to review the topics of this session.
9. Go over the Module Review to prepare trainees for the module exam.
10. Administer the module exam. Record the testing results on the Registration of Training Modules form and submit the form to your Training Program Sponsor.

SESSIONS THREE – THIRTY-TWO

Sessions Three through Thirty-Two are laboratory sessions that provide trainees with an opportunity to practice and complete the Performance Tasks associated with this module.

1. Note that no slide presentation is associated with these laboratory sessions.
2. Demonstrate how to complete GTAW open-root V-groove pipe welds on pipe coupons.
3. Have trainees practice and complete the requirements of Performance Tasks 1 through 4.
4. Document successful Performance Task completions for each trainee on the Performance Profile sheet and submit the results to the Training Program Sponsor.



Materials Checklist for Module 29304, GTAW – Carbon Steel Pipe

Equipment and Materials				
Personal protective equipment:		Squares		
Appropriate flame-retardant clothing		Metal cutting equipment (mechanical or thermal)		
Safety glasses		Angle grinders		
Face shields		Grinding wheels		
Work gloves		Welding machines compatible with GTAW, complete with torches, workpiece clamps, shielding gas hoses, and cables		
Welding gloves		Sufficient supply of filler metal rods for carbon steel		
Welding hood with a lens of the appropriate shade		Sufficient volume of shielding gas with regulators/flowmeters		
Proper footwear as directed by the instructor or training facility provider		Sufficient supply of carbon-steel pipe for practice, 2" to 6" (DN50 to DN150) Schedule 40 or Schedule 80 pipe		
Hearing protection as directed by the instructor or training facility provider		Welding bench with arm suited for position work; alternatively, a welding positioner may be used		
Hard hat as directed by the instructor or training facility provider		Files		
Whiteboard		Chipping hammers		
Dry-erase markers		Wire brushes		
A variety of standard marker sizes		Common hand tools		
Pencils and paper		Soapstone		
Poster board		Tape measures or steel rules		
Flip chart				
<i>Welding Level Three</i> PowerPoint® Presentation				
LCD projector and screen				
Computer (Internet access optional)				
Module Review answer key				
Copies of the Module Examination and answer key				
Performance Profile Sheets				

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.



Lesson Plans for Module 29305

GTAW – LOW ALLOY AND STAINLESS STEEL PIPE

Module Five (29305) reveals that low alloy and stainless steel materials can be more challenging to weld, as the weld puddle tends to be more fluid and harder to manage. With practice and the proper technique however, sound and reliable welds can be created using the GTAW process. This module presents information regarding GTAW of these materials and their unique characteristics. A significant amount of time is devoted to practice in a variety of positions.

Objectives

Learning Objective 1

- State the basic concepts of open-root GTAW of low alloy and stainless steel pipe and how to prepare for welding.
 - a. State the basic concepts of low alloy and stainless steel pipe welding using the GTAW process.
 - b. Identify common welding safety practices.
 - c. Explain how to prepare the area, materials, and equipment for low alloy and stainless steel pipe welding using the GTAW process.

Learning Objective 2

- Describe open-root V-groove pipe welding positions and GTAW pipe-welding techniques.
 - a. Describe the techniques used to apply GTAW to low alloy and stainless steel pipe.
 - b. Describe how to make the root pass with a gas backing.
 - c. Describe the techniques required to produce open-root GTAW low alloy and stainless steel pipe welds in various positions.

Performance Tasks

Performance Task 1

(Learning Objective 2)

- Make GTAW open-root V-groove low alloy or stainless steel pipe welds in the 2G position using the appropriate filler metal and a gas backing.

Performance Task 2

(Learning Objective 2)

- Make GTAW open-root V-groove low alloy or stainless steel pipe welds in the 5G position using the appropriate filler metal and a gas backing.

Performance Task 3

(Learning Objective 2)

- Make GTAW open-root V-groove low alloy or stainless steel pipe welds in the 6G position using the appropriate filler metal and a gas backing.

Teaching Time: 70 hours

(Twenty-Eight 2.5-Hour Sessions)

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

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 requires that trainees work with and around 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 unseen hazards related to welding and the welding environment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

Classroom Equipment and Materials

Whiteboard
Dry-erase markers
A variety of standard marker sizes
Pencils and paper
Poster board
Flip chart
Welding Level Three PowerPoint®
Presentation
LCD projector and screen
Computer (Internet access optional)
Module Review answer key
Copies of the Module Examination and Answer Key (for paper-based exams)
Performance Profile sheets

Equipment and Materials for Laboratories and Performance Testing

Minimum safety equipment:
Appropriate flame-retardant clothing
Safety glasses
Face shields
Work gloves
Welding gloves
Welding hood with a lens of the appropriate shade
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 machines compatible with GTAW, complete with torches, workpiece clamps, shielding gas hoses, and cables
Sufficient volume of shielding gas with regulators/flowmeters
Sufficient volume of backing (purge) gas with regulators/flowmeters

Sufficient supply of stainless steel or low alloy pipe for practice, 2" to 6" (DN50 to DN150) Schedule 40 or Schedule 80
Sufficient supply of filler metal rods for the stainless steel or low alloy material in use
Welding bench with arm suited for position work; alternatively, a welding positioner may be used
Metal cutting equipment (mechanical or thermal)
Angle grinders
Grinding wheels
Squares
Tape measures or steel rules
Soapstone
Files
Chipping hammers
Wire brushes
Common hand tools

Additional Resources

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

AWS F4.1: Recommended Safe Practices for Preparation for Welding and Cutting of Containers and Piping. Miami, FL: American Welding Society.

Modern Welding Technology. Current Edition. Howard B. Cary and Scott Helzer. Englewood Cliffs, NJ: Prentice Hall.

OSHA 1926.351, Arc Welding and Cutting. Current Edition. Washington, DC: Occupational Safety & Health Administration.

The Procedure Handbook of Arc Welding. Current Edition. Cleveland, OH: The James F. Lincoln Arc Welding Foundation.

Welding Handbook, Volumes 1 through 4. Current Edition. Miami, FL: American Welding Society.

Welding Pressure Pipelines and Piping Systems (PDF). The Lincoln Electric Company, Cleveland, OH, USA. <http://www.lincolnelectric.com>. Last accessed May 29, 2015.

There are a number of online resources available for trainees who would like more information on using the GTAW process to weld low alloy and stainless steel materials. 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.

Numerous videos related to the topic are available on the Internet. These can be located by searching "GTAW stainless pipe welding" or similar terms, and using the Video tab on the results page of your preferred search engine.

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 presentations throughout the program.

GTAW – LOW ALLOY AND STAINLESS STEEL PIPE

The Lesson Plan for this module is divided into twenty-eight 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 GTAW of stainless steel and low alloy materials, as well as the required preparations for GTAW pipe welding. This session covers Section 1.0.0.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to initiate a discussion of distortion in stainless steel materials and how to deal with it.
3. Review the basic concepts of GTAW of stainless steel and low alloy materials, and how it differs from other processes.
4. Review common welding safety practices, emphasizing any GTAW-specific safety issues.
5. Describe how to prepare the welding area, welding coupons, and the welding equipment.
6. Review the torch and filler metal techniques required for GTAW of pipe.
7. Use the Section Review questions to review the topics of this session.
3. Review the techniques required to apply the root pass.
4. Discuss the application of a backing gas for open-root pipe welds.
5. Introduce backup flux products and consumable inserts for pipe welds.
6. Review the pipe-welding positions and appropriate weld profiles.
7. Review the techniques required to complete welds in three positions.
8. Use the Section Review questions to review the topics of this session.
9. Go over the Module Review to prepare trainees for the module exam.
10. Administer the module exam. Record the testing results on the Registration of Training Modules form and submit the form to your Training Program Sponsor.

SESSION TWO

Session Two reviews the techniques needed to produce GTAW low alloy and stainless steel pipe welds. The module exam is also completed during this session. This session covers Section 2.0.0.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to introduce trainees to the concepts of fusion welding, also known as autogenous welding.
1. Note that no slide presentation is associated with these laboratory sessions.
2. Demonstrate how to complete GTAW open-root V-groove pipe welds on stainless steel or low alloy pipe coupons, using a backing gas.
3. Have trainees practice and complete the requirements of Performance Tasks 1 through 3.
4. Document successful Performance Task completions for each trainee on the Performance Profile sheet and submit the results to the Training Program Sponsor.

SESSIONS THREE – TWENTY-EIGHT

Sessions Three through Twenty-Eight are laboratory sessions that provide trainees with an opportunity to practice and complete the Performance Tasks associated with this module.



Materials Checklist for Module 29305, GTAW – Low Alloy and Stainless Steel Pipe

Equipment and Materials				
Personal protective equipment:		Squares		
Appropriate flame-retardant clothing		Metal cutting equipment (mechanical or thermal)		
Safety glasses		Angle grinders		
Face shields		Grinding wheels		
Work gloves		Welding machines compatible with GTAW, complete with torches, workpiece clamps, shielding gas hoses, and cables		
Welding gloves		Sufficient supply of filler metal rods for the stainless steel or low alloy material in use		
Welding hood with a lens of the appropriate shade		Sufficient volume of shielding gas with regulators/flowmeters		
Proper footwear as directed by the instructor or training facility provider		Sufficient volume of backing (purge) gas with regulators/flowmeters		
Hearing protection as directed by the instructor or training facility provider		Sufficient supply of stainless steel or low alloy pipe for practice, 2" to 6" (DN50 to DN150) Schedule 40 or Schedule 80		
Hard hat as directed by the instructor or training facility provider		Welding bench with arm suited for position work; alternatively, a welding positioner may be used		
Whiteboard		Files		
Dry-erase markers		Chipping hammers		
A variety of standard marker sizes		Wire brushes		
Pencils and paper		Common hand tools		
Poster board		Soapstone		
Flip chart		Tape measures or steel rules		
<i>Welding Level Three</i> PowerPoint® Presentation				
LCD projector and screen				
Computer (Internet access optional)				
Module Review answer key				
Copies of the Module Examination and answer key				
Performance Profile Sheets				

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.



SMAW – STAINLESS STEEL PLATE AND PIPE GROOVE WELDS

Module Six (29306-16) will help welders understand the differences between welding stainless steel and other metals. The various types of stainless steel require different welding techniques, filler metal composition, and heat treatments. This module covers stainless steel metallurgy and the required SMAW electrodes. An ample amount of time is dedicated to practicing open-root V-groove welds on both stainless steel plate and pipe using the SMAW process.

Objectives

Learning Objective 1

- State special considerations for SMAW of various types of stainless steel and identify compatible electrodes.
 - a. Describe various types of stainless steel.
 - b. Describe methods for controlling carbide precipitation.
 - c. Identify various types of SMAW electrodes compatible with stainless steel.
 - d. Describe the selection and storage of stainless steel electrodes.

Learning Objective 2

- State the basic concepts of SMAW of stainless steel and how to prepare for welding.
 - a. State the basic concepts of SMAW of stainless steel.
 - b. Identify common welding safety practices.
 - c. Explain how to prepare the area, materials, and equipment for SMAW of stainless steel.

Learning Objective 3

- Describe open-root V-groove plate and pipe welding positions and SMAW stainless steel welding techniques.
 - a. Identify and describe plate and pipe welding positions and acceptable weld profiles.
 - b. State general electrode handling considerations for SMAW of stainless steel.
 - c. Describe how to make the root pass.
 - d. Describe the techniques required to produce open-root V-groove SMAW stainless steel plate welds in four positions.
 - e. Describe the techniques required to produce open-root V-groove SMAW stainless steel pipe welds in four positions.

Performance Tasks

Performance Task 1

(Learning Objective 3)

- Make open-root V-groove welds on stainless steel plate in the 1G position.

Performance Task 2

(Learning Objective 3)

- Make open-root V-groove welds on stainless steel plate in the 2G position.

Performance Task 3

(Learning Objective 3)

- Make open-root V-groove welds on stainless steel plate in the 3G position.

Performance Task 4

(Learning Objective 3)

- Make open-root V-groove welds on stainless steel plate in the 4G position.

Performance Task 5

(Learning Objective 3)

- Make open-root V-groove welds on stainless steel pipe in the 1G-ROTATED position.

Performance Task 6

(Learning Objective 3)

- Make open-root V-groove welds on stainless steel pipe in the 2G position.

Performance Task 7

(Learning Objective 3)

- Make open-root V-groove welds on stainless steel pipe in the 5G position.

Performance Task 8

(Learning Objective 3)

- Make open-root V-groove welds on stainless steel pipe in the 6G position.

Elective

Module 29306-16 is an elective for *Welding Level Three*. It is not required for successful level completion.



Teaching Time: 100 hours

(Forty 2.5-Hour Sessions)

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

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 requires that trainees work with and around 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 unseen hazards related to welding and the welding environment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

Classroom Equipment and Materials

Whiteboard
Dry-erase markers
A variety of standard marker sizes
Pencils and paper
Poster board
Flip chart
Welding Level Three PowerPoint® Presentation
LCD projector and screen
Computer (Internet access optional)
Module Review answer key
Copies of the Module Examination and Answer Key (for paper-based exams)
Performance Profile sheets

Equipment and Materials for Laboratories and Performance Testing

Minimum safety equipment:
Appropriate flame-retardant clothing
Safety glasses
Face shields
Work gloves
Welding gloves
Welding hood with a lens of the appropriate shade
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 machines compatible with SMAW and capable of DC welding, complete with electrode holders, workpiece clamps, and cables
Sufficient supply of ¼" to ¾" (6 to 20 mm) thick stainless steel plate
Appropriate plate backing strips (*optional*)
Sufficient supply of stainless steel pipe for practice, 2" to 12" (DN50 to DN300) Schedule 40 or Schedule 80 pipe
Appropriate pipe backing rings (*optional*)
Welding bench with arm suited for position work; alternatively, a welding positioner may be used
Sufficient supply of appropriate SMAW electrodes
Metal cutting equipment (mechanical or thermal)
Angle grinders
Grinding wheels
Squares
Tape measures or steel rules
Soapstone
Files
Chipping hammers
Wire brushes
Common hand tools



Additional Resources

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

AWS A5.4, Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding. Miami, FL: American Welding Society.

AWS F4.1: Recommended Safe Practices for Preparation for Welding and Cutting of Containers and Piping. Miami, FL: American Welding Society.

Modern Welding Technology. Current Edition. Howard B. Cary and Scott Helzer. Englewood Cliffs, NJ: Prentice Hall.

OSHA 1926.351, Arc Welding and Cutting. Current Edition. Washington, DC: Occupational Safety & Health Administration.

The Procedure Handbook of Arc Welding. Current Edition. Cleveland, OH: The James F. Lincoln Arc Welding Foundation.

Welding Handbook, Volumes 1 through 4. Current Edition. Miami, FL: American Welding Society.

Welding Pressure Pipelines and Piping Systems (PDF). The Lincoln Electric Company, Cleveland, OH, USA. <http://www.lincolnelectric.com>. Last accessed May 29, 2015.

There are a number of online resources available for trainees who would like more information on stainless steel welding using the SMAW process. 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.

Numerous videos related to the topic are available on the Internet. These can be located by searching “SMAW stainless welding” or similar terms, and using the Video tab on the results page of your preferred search engine.

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 presentations throughout the program.



SMAW – STAINLESS STEEL PLATE AND PIPE GROOVE WELDS

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 provides a refresher on stainless steel metallurgy and presents the SMAW electrodes used for stainless steel. This session covers Section 1.0.0.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to encourage discussion and thought about the use of SMAW on stainless steel.
3. Compare and contrast the various types of stainless steel.
4. Review carbide precipitation, its causes, and its effects.
5. Discuss stainless steel electrodes and their storage requirements.
6. Use the Section Review questions to review the topics of this session.

SESSION TWO

Session Two reviews the basic concepts of SMAW on stainless steel. In addition, safety practices and welding preparations are presented. This session covers Sections 2.0.0 through 3.1.3.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to share stainless steel SMAW tips from an industry expert with the class.
3. Discuss information relevant to the use of SMAW on stainless steel.
4. Review common welding safety practices, emphasizing any practices directly related to SMAW.
5. Describe how to prepare the welding area, equipment, and both plate and pipe coupons.
6. Identify the four primary welding positions for both plate and pipe.
7. Review the characteristics of an acceptable weld profile.
8. Use the Section Review questions to review the topics of this session.

SESSION THREE

Session Three provides specific guidance to be used during plate and pipe welding practice. This session covers Sections 3.2.0 through 3.5.4.

1. Show the Session Three PowerPoint® presentation.
2. Use the Kickoff Activity to share stainless steel SMAW tips from a second industry expert, providing an opportunity for trainees to compare the opinions and techniques of multiple experts.
3. Review the techniques required to apply an SMAW root pass on stainless steel.
4. Review the details related to each plate- and pipe-welding position.
5. Use the Section Review questions to review the topics of this session.
6. Go over the Module Review to prepare trainees for the module exam.
7. Administer the module exam. Record the testing results on the Registration of Training Modules form and submit the form to your Training Program Sponsor.

SESSIONS FOUR THROUGH FORTY

Sessions Four through Forty are laboratory sessions that provide an opportunity for trainees to practice and complete the Performance Tasks associated with this module.

1. Note that no slide presentation is associated with these laboratory sessions.
2. Demonstrate how to complete SMAW V-groove plate welds on plate coupons.
3. Have trainees practice and complete the requirements of Performance Tasks 1 through 4.
4. Demonstrate how to complete SMAW V-groove pipe welds on pipe coupons.
5. Have trainees practice and complete the requirements of Performance Tasks 5 through 8.
6. Document successful Performance Task completions for each trainee on the Performance Profile sheet and submit the results to the Training Program Sponsor.



Materials Checklist for Module 29306, SMAW – Stainless Steel Plate and Pipe Groove Welds

Equipment and Materials				
Personal protective equipment:		Squares		
Appropriate flame-retardant clothing		Tape measures or steel rules		
Safety glasses		Soapstone		
Face shields		Sufficient supply of appropriate SMAW electrodes		
Work gloves		Metal cutting equipment (mechanical or thermal)		
Welding gloves		Angle grinders		
Welding hood with a lens of the appropriate shade		Grinding wheels		
Proper footwear as directed by the instructor or training facility provider		Welding machines compatible with SMAW and capable of DC welding, complete with electrode holders, workpiece clamps, and cables		
Hearing protection as directed by the instructor or training facility provider		Sufficient supply of stainless Appropriate pipe backing rings (optional) steel pipe for practice, 2" to 12" (DN50 to DN300) Schedule 40 or Schedule 80 pipe		
Hard hat as directed by the instructor or training facility provider		Sufficient supply of ¼" to ¾" (6 to 20 mm) thick stainless steel plate		
Whiteboard		Welding bench with arm suited for position work; alternatively, a welding positioner may be used		
Dry-erase markers		Appropriate plate backing strips (<i>optional</i>)		
A variety of standard marker sizes		Appropriate pipe backing rings (<i>optional</i>)		
Pencils and paper		Files		
Poster board		Chipping hammers		
Flip chart		Wire brushes		
<i>Welding Level Three</i> PowerPoint® Presentation		Common hand tools		
LCD projector and screen				
Computer (Internet access optional)				
Module Review answer key				
Copies of the Module Examination and answer key				
Performance Profile Sheets				

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.

