

Lesson Plans for Module 29101

WELDING SAFETY

Welding Safety (Module 29101) This module 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 the welding craft and its apprenticeship program.

- a. Define welding and its common forms.
- b. Summarize the NCCER training and apprenticeship program.

Learning Objective 2

List a welder's personal protective equipment (PPE) and describe its role.

- a. Identify and describe body, foot, and hand PPE.
- b. Identify and describe head PPE.

Learning Objective 3

Summarize welding environment hazards and associated safety practices.

- a. Outline welding safety and the factors that contribute to accidents.
- b. List general workplace safety practices.
- c. Describe fire safety, hot work permits, and fire watch requirements.
- d. Describe confined spaces and their safety practices.
- e. Summarize welding equipment safety practices.
- f. Explain respiratory hazards, ventilation, and associated safety equipment.
- g. Describe using a safety data sheet (SDS) to handle materials safely.

Performance Tasks

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

Recommended Teaching Time: 5.0 hours

Before You Begin

As you prepare for each Section, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® Presentations and/or Dynamic Lecture Presentations), 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 PowerPoint® presentations and Performance Profile Sheets for this module from NCCER's Instructor Resource Center at www.nccer.org/irc.

OXYFUEL CUTTING

Oxyfuel Cutting (Module 29102) 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 its safety procedures.

- Summarize oxyfuel cutting.
- List oxyfuel cutting safety procedures.

Learning Objective 2

Summarize oxyfuel cutting equipment.

- Identify and describe oxyfuel cutting gases and their storage cylinders.
- Describe oxyfuel cutting regulators and hoses.
- Describe oxyfuel cutting torches and tips.
- Describe specialized oxyfuel cutting equipment.
- Describe oxyfuel accessories.

Learning Objective 3

Outline safely setting up, lighting, and shutting down oxyfuel equipment.

- Explain how to set up oxyfuel equipment.
- Explain how to leak test oxyfuel equipment.
- Explain how to light, adjust, and shut down oxyfuel equipment.

Learning Objective 4

Outline common oxyfuel cutting procedures.

- Identify good and bad cuts, as well as what creates them.
- Explain how to cut, bevel, wash, and gouge.

Performance Tasks

Performance Task 1 (Learning Objective 3)

Set up oxyfuel cutting equipment.

Performance Task 2 (Learning Objectives 3)

Light and adjust an oxyfuel torch.

Performance Task 3 (Learning Objectives 3)

Shut down oxyfuel cutting equipment.

Performance Task 4 (Learning Objectives 3)

Disassemble oxyfuel cutting equipment.

Performance Task 5 (Learning Objectives 3)

Change gas cylinders.

Performance Task 6 (Learning Objective 4)

Cut instructor-specified shapes from various thicknesses of steel.

Performance Task 7 (Learning Objective 4)

Wash metal with oxyfuel equipment.

Performance Task 8 (Learning Objective 4)

Gouge metal with oxyfuel equipment.

Performance Task 9 (Learning Objective 4)

Cut straight lines and bevels either with a track cutter or manually with/without a guide.

Recommended Teaching Time: 17.5 hours

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Lesson Plans for Module 29103

PLASMA ARC CUTTING

Plasma Arc Cutting (Module 29103) introduces the trainees to the methods and procedures related to the plasma arc cutting process. Trainees will learn safety procedures, equipment setup, gas types, flow rates, and techniques.

Objectives

Learning Objective 1

Describe plasma arc cutting and its safety procedures.

- a. Summarize plasma arc cutting.
- b. List plasma arc cutting safety procedures.

Learning Objective 2

Summarize plasma arc cutting equipment.

- a. Describe plasma arc cutting power units.
- b. Describe plasma arc cutting gases and gas control devices.
- c. Describe plasma arc cutting torches and accessories.

Learning Objective 3

Outline setting up, safely operating, and maintaining plasma arc cutting equipment.

- a. Explain how to set up a plasma arc cutting project.
- b. Explain how to operate plasma arc cutting equipment safely.
- c. Explain how to maintain plasma arc cutting equipment.

Performance Tasks

Performance Task 1 (Learning Objective 3)

Set up plasma arc cutting equipment.

Performance Task 2 (Learning Objective 3)

Select amperage, gas pressure, and flow rate appropriate to the metal type and thickness.

Performance Task 3 (Learning Objective 3)

Square-cut metal with plasma arc cutting equipment.

Performance Task 4 (Learning Objective 3)

Bevel-cut metal with plasma arc cutting equipment.

Performance Task 5 (Learning Objective 3)

Pierce and cut slots in metal with plasma arc cutting equipment.

Performance Task 6 (Learning Objective 3)

Dismantle and store plasma arc cutting equipment.

Recommended Teaching Time: 7.5 hours

Before You Begin

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

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Lesson Plans for Module 29104

AIR-CARBON ARC CUTTING AND GOUGING

Air-Carbon Arc Cutting and Gouging (Module 29104) introduces the trainees to the methods and procedures related to the Air-Carbon Arc Cutting and Gouging process. Trainees will identify related air-carbon arc cutting and gouging equipment and consumables and will be tested on their ability to use this equipment correctly and safely.

Objectives

Learning Objective 1

Describe air-carbon arc cutting and its safety procedures.

- a. Summarize air-carbon arc cutting.
- b. List air-carbon arc cutting safety procedures.

Learning Objective 2

Summarize air-carbon arc cutting equipment.

- a. Describe air-carbon arc power units.
- b. Describe air-carbon arc torches.
- c. Describe air-carbon arc electrodes.

Learning Objective 3

Outline setting up, safely operating, and caring for air-carbon arc equipment.

- a. Explain how to set up an air-carbon arc cutting project.
- b. Explain how to gouge and wash metals with air-carbon arc cutting equipment.
- c. Explain how to maintain air-carbon arc cutting equipment.

Performance Tasks

Performance Task 1 (Learning Objective 3)

Set up air-carbon arc cutting equipment.

Performance Task 2 (Learning Objective 3)

Select and install air-carbon arc cutting electrodes.

Performance Task 3 (Learning Objective 3)

Gouge metal with air-carbon arc cutting equipment.

Performance Task 4 (Learning Objective 3)

Wash metal with air-carbon arc cutting equipment.

Performance Task 5 (Learning Objective 3)

Dismantle and store air-carbon arc cutting equipment.

Recommended Teaching Time: 5 hours

Before You Begin

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Lesson Plans for Module 29105

BASE METAL PREPARATION

Base Metal Preparation (Module 29105) 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

Summarize metal properties and safely preparing metals for welding.

- List safety procedures for preparing metals.
- List the types and properties of carbon, alloy, and stainless steels.
- Outline cleaning metals correctly and safely.

Learning Objective 2

Outline joint and weld types.

- Summarize loads and the ways they affect welded joints.
- Summarize joint and weld types, along with their qualities.
- Describe a Welding Procedure Specification (WPS).

Learning Objective 3

Outline preparing joints for welding.

- Describe mechanically preparing joints for welding.
- Describe thermally preparing joints for welding.

Performance Tasks

Performance Task 1 (Learning Objective 3)

Mechanically create a 22½-degree bevel ($\pm 2\frac{1}{2}$ degrees) on the edge of a ¼" to ¾" (~6 mm to 20 mm) thick carbon steel plate.

Performance Task 2 (Learning Objective 3)

Thermally create a 22½-degree bevel ($\pm 2\frac{1}{2}$ degrees) on the edge of a ¼" to ¾" (~6 mm to 20 mm) thick carbon steel plate.

Recommended Teaching Time: 10.0 hours

Before You Begin

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

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WELD QUALITY

Weld Quality (Module 29106) introduces the trainees to the methods and procedures used 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

Summarize welding codes, code standards organizations, and welding qualifications.

- a. Identify welding codes and the key welding code standards organizations.
- b. Define and describe welding qualifications.

Learning Objective 2

Identify weld discontinuities and their causes.

- a. Describe acceptable and unacceptable weld profiles.
- b. Describe common discontinuities and their causes.

Learning Objective 3

Summarize nondestructive and destructive weld tests.

- a. Describe visual weld inspection methods.
- b. Describe nondestructive weld testing methods.
- c. Describe destructive weld testing methods.

Learning Objective 4

Summarize welder performance qualification testing.

- a. Describe welder performance qualifications.
- b. List AWS, ASME, and API welder qualification testing requirements.
- c. Describe a welder performance qualification test.

Performance Tasks

Performance Task 1 (Learning Objective 3)

Visually inspect (VT) a fillet and/or groove weld and complete an inspection report.

Recommended Teaching Time: 10.0 hours

Before You Begin

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

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Lesson Plans for Module 29107

SMAW—EQUIPMENT AND SETUP

SMAW—Equipment and Setup (Module 29107) 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

Describe SMAW and its associated electrical and safety principles.

- Summarize SMAW and the electrical principles behind it.
- List SMAW safety procedures.

Learning Objective 2

Summarize SMAW equipment.

- Identify and describe SMAW machines.
- Identify and describe welding cables and connectors.
- Identify and describe tools that clean welds.

Learning Objective 3

Outline setting up, safely operating, and maintaining SMAW equipment.

- Explain how to set up SMAW equipment.
- Explain how to start and stop SMAW equipment.
- Explain how to maintain SMAW equipment.

Performance Task

Performance Task 1 (Learning Objective 3)

Set up a welding machine for SMAW work.

Recommended Teaching Time: 5.0 hours

Before You Begin

As you prepare for each Section, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® Presentations and/or Dynamic Lecture Presentations), 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 PowerPoint® presentations and Performance Profile Sheets for this module from NCCER's Instructor Resource Center at www.nccer.org/irc.

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.

SMAW ELECTRODES

SMAW Electrodes (Module 29108) 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.

Objectives

Learning Objective 1

Summarize SMAW electrodes and their classification system.

- a. Describe the AWS filler metal specification system and electrode characteristics.
- b. Describe the four main electrode groups.

Learning Objective 2

Summarize how to select, handle, and care for electrodes.

- a. Describe selecting the correct electrode.
- b. Describe properly handling and storing electrodes.

Performance Tasks

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

Recommended Teaching Time: 2.5 hours

Before You Begin

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

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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.

Lesson Plans for Module 29109

SMAW—BEADS AND FILLET WELDS

SMAW—Beads and Fillet Welds (Module 29109) introduces the trainees to 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

Summarize fillet welds and preparing to weld them.

- a. Identify fillet welds and their properties.
- b. Outline preparing for fillet welding.

Learning Objective 2

Summarize basic SMAW techniques, as well as how to create beads and fillets.

- a. Describe how to strike and control the arc to produce a weld pass.
- b. Describe producing stringer and weave beads, as well as surfacing welds.
- c. Describe fillet welding in all positions.

Performance Tasks

Performance Task 1 (Learning Objective 1)

Safely set up SMAW equipment for fillet welding.

Performance Task 2 (Learning Objective 2)

Strike an arc.

Performance Task 3 (Learning Objective 2)

Use E6010/E6011 and E7018 electrodes to make stringer, weave, and surfacing beads.

Performance Task 4 (Learning Objective 2)

Use E6010/E6011 and E7018 electrodes to make flat fillet (1F) welds.

Performance Task 5 (Learning Objective 2)

Use E6010/E6011 and E7018 electrodes to make horizontal fillet (2F) welds.

Performance Task 6 (Learning Objective 2)

Use E6010/E6011 and E7018 electrodes to make vertical fillet (3F) welds.

Performance Task 7 (Learning Objective 2)

Use E6010/E6011 and E7018 electrodes to make overhead fillet (4F) welds.

Recommended Teaching Time: 100.0 hours

Before You Begin

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Lesson Plans for Module 29110

JOINT FIT-UP AND ALIGNMENT

Joint Fit-Up and Alignment (Module 29110) introduces the trainees to the techniques and procedures to perform proper joint fit-up and inspection. Trainees will become familiar with using special tools, and measuring devices to ensure quality during welding.

Objectives

Learning Objective 1

Summarize fit-up and alignment tools.

- a. Identify and describe weldment positioning equipment.
- b. Identify and describe plate alignment tools.
- c. Identify and describe pipe and flange alignment tools.
- d. Identify and describe fit-up gauges and measuring devices.

Learning Objective 2

Summarize managing weldment distortion.

- a. Explain weldment distortion and its causes.
- b. Explain the tools and techniques that control weldment distortion.

Performance Tasks

Performance Task 1 (Learning Objective 1)

Use specialized tools to fit up plate and pipe joints.

Performance Task 2 (Learning Objective 1)

Use gauges and other measuring tools to check joints for proper fit-up and alignment.

Recommended Teaching Time: 5.0 hours

Before You Begin

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

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Lesson Plans for Module 29111

SMAW—GROOVE WELDS WITH BACKING (PLATE)

SMAW—Groove Welds with Backing (Plate) (Module 29111) 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

Summarize groove weld types and preparing to weld them.

- a. Identify groove welds and their properties.
- b. Outline preparing for making groove welds with backing.

Learning Objective 2

Summarize techniques for making V-groove welds with backing.

- a. Describe making V-groove welds with backing in the 1G and 2G positions.
- b. Describe making V-groove welds with backing in the 3G and 4G positions.

Performance Tasks

Performance Task 1 (Learning Objective 1)

Safely set up SMAW equipment for groove welding.

Performance Task 2 (Learning Objective 2)

Use E7018 electrodes to make flat (1G) V-groove welds with backing.

Performance Task 3 (Learning Objective 2)

Use E7018 electrodes to make horizontal (2G) V-groove welds with backing.

Performance Task 4 (Learning Objective 2)

Use E7018 electrodes to make vertical (3G) V-groove welds with backing.

Performance Task 5 (Learning Objective 2)

Use E7018 electrodes to make overhead (4G) V-groove welds with backing.

Recommended Teaching Time: 60.0 hours

Before You Begin

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

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Lesson Plans for Module 29112

SMAW—OPEN-ROOT GROOVE WELDS (PLATE)

SMAW—Open-Root Groove Welds (Plate) (Module 29112) introduces trainees to the method 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

Summarize groove weld types and preparing to weld them.

- Identify groove welds and their properties.
- Outline preparing for making open-root single V-groove welds.

Learning Objective 2

Summarize techniques for making open-root single V-groove welds.

- Describe producing the root pass for open-root single V-groove welds.
- Describe making open-root single V-groove welds in the 1G and 2G positions.
- Describe making open-root single V-groove welds in the 3G and 4G positions.

Performance Tasks

Performance Task 1 (Learning Objective 1)

Safely set up SMAW equipment for groove welding.

Performance Task 2 (Learning Objective 2)

Use E6010/E6011 and E7018 electrodes to make flat (1G) open-root single V-groove welds.

Performance Task 3 (Learning Objective 2)

Use E6010/E6011 and E7018 electrodes to make horizontal (2G) open-root single V-groove welds.

Performance Task 4 (Learning Objective 2)

Use E6010/E6011 and E7018 electrodes to make vertical (3G) open-root single V-groove welds.

Performance Task 5 (Learning Objective 2)

Use E6010/E6011 and E7018 electrodes to make overhead (4G) open-root single V-groove welds.

Recommended Teaching Time: 60.0 hours

Before You Begin

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

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