

Module Overview

This module describes how a set of drawings is structured, from the complete vessel down to the smallest part. The module provides trainees with the opportunity to practice locating assemblies and components on the types of complex drawings they will encounter in their work.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the *Maritime Industry Fundamentals*; *Maritime Structural Fitter Level One*; and *Maritime Structural Fitter Level Two*.

Objectives

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

1. Describe how drawings for a vessel are structured.
2. Interpret the types of drawings commonly used by structural fitters.
 - a. Assembly drawings
 - b. Mechanical drawings
 - c. Foundation drawings
3. Explain the drawing change process.

Performance Task

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

1. Use a drawing to establish the work lines for an individual structure.

Materials and Equipment List

Multimedia projector and screen
Maritime Structural Fitter Level Three
PowerPoint® Presentation Slides
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
(PPE) required for fitting procedures

A partial drawing set for a vessel (supplied with this module), including:
GA Drawings
Assembly drawings
Mechanical drawings
Foundation drawings
Measuring and layout tools:
Steel rules
Steel tape measures
Steel squares
Combination sets
Chalk lines
Module Examination*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires that the trainees perform structural fitting tasks. Ensure that trainees are briefed on fire and shop safety policies prior to performing any work.

Additional Resources

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

Ship Construction. D.J. Eyres, G. J. Bruce. Elsevier: Burlington, MA.

Construction of Marine and Offshore Structures. Ben C. Gerwick, Jr. CRC Press: New York, NY.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 40 hours are suggested to cover *Advanced Structural Print Reading*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I and II. Introduction and Layout	
A. Introduction	_____
1. General Arrangement Drawings	_____
Sessions III through VIII. Working With Drawings	
A. Working With Drawings	_____
1. Assembly Drawings	_____
2. Foundation Drawings	_____
3. Mechanical Drawings	_____
4. Doors, Scuttles, and Hatches	_____
Sessions IX through XII. PT/Laboratory	
A. PT/Laboratory	_____
1. Have trainees lay out work lines for various structures. This laboratory corresponds to Performance Task 1.	
Sessions XIII through XV. Drawing Change Control	
A. Drawing Change Control	_____
1. Configuration Control	_____
2. Retrofits	_____

Session XVI. Review and Testing

A. Review

B. Module Examination

1. Trainees must score 70 percent or higher to receive recognition from NCCER.
2. Record the testing results on the Registration of Training Modules Form, and submit the report to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on the Registration of Training Modules Form, and submit the report to the Training Program Sponsor.

Module Overview

This module covers layout, assembly, installation, and alignment of decks, shell plates, foundations, and other structural members using the skills learned in the preceding levels.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the *Maritime Industry Fundamentals*; *Maritime Structural Fitter Level One*; *Maritime Structural Fitter Level Two*; and *Maritime Structural Fitter Level Three*, Module 86301-15.

Objectives

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

1. Describe tools and methods use to lay out mold lines, radius corners, and penetrations.
2. Describe proper fit procedures related to fitting tasks in all positions:
 - Longitudinals
 - Shell plating
 - Bulkheads/deck plates
 - Frames
 - Foundations
 - Miscellaneous structural items such as chocks, headers, collars, brackets, and clips
 - Watertight and non-watertight doors and hatches
3. Describe how to assemble, erect, and set a modular unit.

Performance Tasks

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

1. Lay out a door opening.
2. Lay out bulkhead and deck penetrations.
3. Lay out, build, and install a simple foundation.
4. Install doors and hatches.
5. Complete an inspection checklist using a structural drawing and common fitting practices.

Materials and Equipment List

Multimedia projector and screen
Maritime Structural Fitter Level Three
PowerPoint® Presentation Slides

Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment
(PPE) required for fitting procedures

Steel plate

Steel angle

Tools required for fitting and installing doors

Appropriate structural drawings

Measuring and layout tools:

Steel rules

Steel tape measures

Steel squares

Combination sets

Dividers

Chalk lines

Center and prick punches

Watertight door

Joiner door

Hatch

Inspection checklists

Module Examinations*

Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires that the trainees perform structural fitting tasks. Ensure that trainees are briefed on fire and shop safety policies prior to performing any work.

Additional Resources

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

Ship Construction, D.J. Eyres, G. J. Bruce. Elsevier: Burlington, MA.

Construction of Marine and Offshore Structures, Ben C. Gerwick, Jr. CRC Press: New York, NY.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 80 hours are suggested to cover *Fitting III*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I and II. Introduction and Layout	
A. Introduction	_____
1. Safety Review	_____
B. Layout	_____
1. Layout Tools	_____
2. Layout Tasks	_____
Sessions III through X. PT/Laboratory	
A. PT/Laboratory	_____
1. Have trainees lay out bulkhead and deck penetrations, and door openings. This laboratory corresponds to Performance Tasks 1 and 2.	
Sessions XI through XIII. Fitting Tasks	
A. Fitting Tasks	_____
1. Installing Stiffening Members	_____
2. Fitting a Frame Over Stiffeners	_____
3. Installing Shell Plating	_____
4. Building and Setting a Foundation	_____
5. Installing a Watertight Door	_____
6. Joiner Doors	_____
7. Hatches	_____
8. Installing a Bulkhead	_____
9. Pulling Sheerstrake to a Deck	_____
Sessions XIV through XIX. PT/Laboratory	
A. PT/Laboratory	_____
1. Have trainees lay out, build, and install a simple foundation. This laboratory corresponds to Performance Task 3.	

Sessions XX through XXVII. PT/Laboratory

A. PT/Laboratory

1. Have trainees install doors and hatches. This laboratory corresponds to Performance Task 4.

Sessions XXVIII through XXXI. Ship Construction

A. Ship Construction

1. Quality Control

B. PT/Laboratory

1. Have trainees complete an inspection checklist using a structural drawing and common fitting practices. This laboratory corresponds to Performance Task 5.

Session XXXII. Review and Testing

A. Review

B. Module Examination

1. Trainees must score 70 percent or higher to receive recognition from NCCER.
2. Record the testing results on the Registration of Training Modules Form, and submit the report to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on the Registration of Training Modules Form, and submit the report to the Training Program Sponsor.

GMAW and FCAW: Equipment and Filler Metals Annotated Instructor's Guide

Module 29205-09

Module Overview

This module provides an overview of the equipment required for gas metal arc welding and flux-cored arc welding. Topics include safety practices, welding power sources, wire feeders, guns, equipment setup, and filler metals.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Maritime Industry Fundamentals*; *Maritime Structural Fitter Level One*; and *Maritime Structural Fitter Level Two*.

Objectives

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

1. Explain gas metal arc welding (GMAW) and flux-cored arc welding (FCAW) safety.
2. Explain the characteristics of welding current and power sources.
3. Identify and explain the use of GMAW and FCAW equipment:
 - Spray transfer
 - Globular
 - Short circuiting
 - Pulse
4. Identify and explain the use of GMAW and FCAW shielding gases and filler metals.
5. Set up GMAW and FCAW equipment and identify tools for weld cleaning.

Performance Task

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

1. Set up GMAW and FCAW equipment with appropriate shielding gases and filler metals.

Materials and Equipment List

Markers/chalk	Manufacturer's instruction manual for an engine-driven generator
Pencils and scratch paper	Leather welding gloves
Whiteboard/chalkboard	Leather welding jacket or sleeves
<i>Structural Fitter Level Three</i> PowerPoint®	Welding shield or helmet
Presentation Slides can be downloaded (with your access code) from www.nccerirc.com	Selection of shades 5 to 14 tinted lenses
Multimedia projector and screen	Cutting goggles
Desktop or laptop computer	FCAW welding equipment
Appropriate personal protective equipment	Electrode wire, 0.45" dual shielded flux-cored carbon steel
Engine-driven power source	GMAW welding equipment
Inverter power source	Carbon steel wire electrode
Welding cable	Shielding gas
Lugs and quick disconnects	Welding bench with arm for position work
Wire feeders	Portable angle-head grinders
Wire straighteners	Framing square
GMAW/FCAW-G guns	Soapstone
Shielding gas regulators/flowmeters	Tape measure
Labeled samples of GMAW/FCAW filler wire in various types and sizes	Pliers
Electrical plugs and outlets	Half-round bastard file
Workpiece clamps	

continued

Wire brush
Chipping hammer

Module Examinations*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Trainees will be required to set up GMAW and FCAW equipment with appropriate shielding gases and filler metals. Ensure that trainees are properly briefed on the safe use of arc welding equipment and shielding gases and are familiar with all appropriate safety precautions and procedures. Ensure that all labs are equipped with charged fire extinguishers.

Additional Resources

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

- AWS B1.10:1999 Guide for the Nondestructive Examination of Welds.* Miami, FL: American Welding Society.
- AWS B1.11:2000 Guide for the Visual Examination of Welds.* Miami, FL: American Welding Society.
- AWS D3.5-93R Guide for Steel Hull Welding.* Miami, FL: American Welding Society, 1993.
- Lincoln Electric website: <http://www.lincolnelectric.com> offers sources for products and training.
- Modern Welding Technology.* Howard B. Cary. Englewood Cliffs, NJ: Prentice Hall, Inc.
- OSHA 1910.269, Appendix C, Protection from Step and Touch Potentials.* Current edition. Washington, DC: Occupational Safety & Health Administration (OSHA).
- OSHA 1926.351, Arc Welding and Cutting.* Current edition. Washington, DC: Occupational Safety & Health Administration (OSHA).
- Welding Handbook.* Volume 1. *Welding Science & Technology.* Miami, FL: American Welding Society, 2001.
- Welding Handbook.* Volume 2, Part 1: *Welding Processes.* Miami, FL: American Welding Society, 2004.

Teaching Time for this Module

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

Topic	Planned Time
Session I. Introduction; GMAW and FCAW	
A. Introduction	_____
B. Safety Practices	_____
C. Characteristics of Welding Current	_____
D. Welding Power Sources	_____
E. GMAW and FCAW Equipment	_____
1. GMAW Metal Transfer Modes	_____
2. FCAW Metal Transfer Process	_____
3. GMAW Power Sources	_____
4. Welding Cable	_____
5. External Wire Feeders	_____
6. GMAW/FCAW-G Guns	_____
7. FCAW-S Guns	_____
8. Shielding Gas Supply	_____

Session II. Shielding Gases and Filler Metals

A. Shielding Gases

1. Shielding Gas Characteristics
2. Shielding Gas Selection
3. Shielding Gas Flow Rate

B. Filler Metals

1. GMAW Filler Metals
2. FCAW Filler Metals

Session III. Welding Equipment Setup

A. Welding Equipment Setup

1. Selecting a Power Source
2. Positioning the Equipment
3. Moving Welding Power Sources
4. Connecting the Shielding Gas
5. Selecting and Installing Filler Wire
6. Placing the Workpiece Clamp
7. Energizing the Power Source
8. Starting Engine-Driven Generators/Alternators

B. PT/Laboratory

Trainees practice setting up GMAW and FCAW equipment with appropriate shielding gases and filler metals. This laboratory corresponds to Performance Task 1.

Session IV. Hand Tools; Review and Testing

A. Hand Tools for Weld Cleaning

B. Review

C. Module Examination

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

D. Performance Testing

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

Module Overview

This module explains how to make fillet and open V-groove welds on carbon steel plate using gas metal arc welding (GMAW) and flux-cored arc welding (FCAW) processes in all positions.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Maritime Industry Fundamentals*; *Maritime Structural Fitter Level One*; and *Maritime Structural Fitter Level Two*.

Objectives

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

1. Perform GMAW-S (short-circuit) multiple-pass fillet welds on carbon steel plate coupons in multiple positions, using solid or composite wire and shielding gas.
2. Perform GMAW-S (short-circuit) multiple-pass V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using solid or composite wire and shielding gas.
3. Perform GMAW spray fillet and V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using solid or composite wire and shielding gas.
4. Perform FCAW multiple-pass fillet welds on carbon steel plate coupons in multiple positions, using flux-cored wire and, if required, shielding gas.
5. Perform FCAW multiple-pass V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using flux-cored wire and, if required, shielding gas.

Performance Tasks

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

1. Make multiple-pass GMAW-S (short-circuit) fillet welds on carbon steel plate coupons in the following positions, using solid or composite wire:
 - 1F
 - 2F
 - 3F
 - 4F
2. Make multiple-pass FCAW-G/GM (gas-shielded) or FCAW-S (self-shielded) fillet welds on carbon steel plate coupons in the following positions:
 - 1F
 - 2F
 - 3F
 - 4F
3. Make multiple-pass FCAW-G/GM (gas shielded) or FCAW-S (self-shielded) V-groove welds on carbon steel plate coupons in the following positions (with or without backing):
 - 1G
 - 2G
 - 3G
 - 4G
4. Make multiple-pass GMAW-S (short-circuit) V-groove welds on carbon steel plate coupons in the following positions (with or without backing), using solid or composite wire:
 - 1G
 - 2G
 - 3G
 - 4G
5. Make multiple-pass GMAW spray fillet welds on carbon steel plate coupons in the following positions, using solid or composite wire:
 - 1F
 - 2F
6. Make multiple-pass GMAW spray V-groove welds on carbon steel plate coupons in the 1G position (with or without backing), using solid or composite wire.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Trainees will be required to make fillet and open V-groove welds on carbon steel plate coupons using GMAW and FCAW. Ensure that trainees are properly briefed on the safe use of arc welding equipment and are familiar with all appropriate safety precautions and procedures. Check to be sure that all labs are equipped with charged fire extinguishers.

Materials and Equipment List

Markers/chalk	Soapstone
Pencils and scratch paper	Tape measure
Whiteboard/chalkboard	Pliers
<i>Structural Fitter Level Three PowerPoint</i> [®]	Half-round bastard file
Presentation Slides can be downloaded (with your access code) from www.nccerirc.com	Wire brush
Multimedia projector and screen	Chipping hammer
Desktop or laptop computer	Workpiece clamps
Appropriate personal protective equipment	Examples of the following:
FCAW welding equipment	Beads created with different travel speed settings
GMAW welding equipment	Good and bad weld beads
Shielding gas	Stringer beads
Flux-cored wire	Weave beads
Solid or composite wire	Properly and improperly terminated welds
Backing materials	Proper and improper overlapping beads
Plate steel for coupons, ¼" to ¾"	Pads made using stringer and weave beads
Welding bench with arm for position work	Fillet welds from all four welding positions
Portable angle-head grinders with extra grinding discs	Fillet welds that have been sawed to expose their profiles
Anti-splatter material	Ground and unground root passes
MSDS for each cleaning agent used	Broken apart open V-groove root pass weld
Bevel gauge(s)	Module Examinations*
Framing square	Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Additional Resources

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

- AWS B1.10:1999 Guide for the Nondestructive Examination of Welds*. Miami, FL: American Welding Society.
- AWS B1.11:2000 Guide for the Visual Examination of Welds*. Miami, FL: American Welding Society.
- AWS C5.6-89 Recommended Practices for Gas Metal Arc Welding*. Miami, FL: American Welding Society, 1989.
- AWS D3.5-93R Guide for Steel Hull Welding*. Miami, FL: American Welding Society, 1993.
- E1.10 2009 Product Catalog*. Cleveland, OH: The Lincoln Electric Company.
- GMAW Welding Guide*. Cleveland, OH: The Lincoln Electric Company, 2006.
- Lincoln Electric offers sources for products and training. Website: <http://www.lincolnelectric.com>.
- OSHA 1910.269, Appendix C, Protection from Step and Touch Potentials*. Current edition. Washington, DC: Occupational Safety & Health Administration (OSHA).
- OSHA 1926.351, Arc Welding and Cutting*. Current edition. Washington, DC: Occupational Safety & Health Administration (OSHA).
- The Procedure Handbook of Arc Welding*. 14th ed. Cleveland, OH: The James F. Lincoln Arc Welding Foundation, 2000.
- Welding Handbook*. Volume 1. *Welding Science & Technology*. Miami, FL: American Welding Society, 2001.
- Welding Handbook*. Volume 2, Part 1: *Welding Processes*. Miami, FL: American Welding Society, 2004.

Teaching Time for this Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 80 hours are suggested to cover *GMAW and FCAW: Plate*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; GMAW and FCAW; Welding Safety; Equipment Setup	
A. Introduction	_____
1. The GMAW Process	_____
2. The FCAW Process	_____
3. GMAW and FCAW Equipment	_____
B. Welding Safety	_____
1. Protective Clothing and Equipment	_____
2. Fire/Explosion Prevention	_____
3. Work Area Ventilation	_____
C. Welding Equipment Setup	_____
1. Preparing the Welding Area	_____
2. Preparing the Practice Coupons	_____
3. Welding Machine	_____
4. Welding Voltage, Amperage, and Travel Speed	_____
5. Gun Position	_____
6. Electrode Extension, Stickout, and Standoff Distance	_____
7. Gas Nozzle Cleaning	_____
D. Laboratory	_____
Have trainees set up the welding area and prepare plate coupons for GMAW and FCAW fillet and groove welds.	
Sessions II–III. Bead Types; Laboratory	
A. Bead Types	_____
1. Stringer Beads	_____
2. Weave Beads	_____
3. Weld Restarts	_____
4. Weld Terminations	_____
5. Overlapping Beads	_____
B. Laboratory	_____
Have trainees set up GMAW and FCAW equipment and practice starting, restarting, and terminating welds; altering gun angles to see the effects on stringer and weave beads; and overlapping beads to build a pad.	
Sessions IV–XV. Fillet Welds	
A. Flat (1F) Position Welds	_____
1. PT/Laboratory	_____
Have trainees practice using GMAW (spray and/or short-circuit transfer) and FCAW equipment, filler wire, and shielding gases to make multiple-pass fillet welds on carbon steel plate coupons in the 1F position. This laboratory corresponds to Performance Tasks 1, 2, and 5.	

B. Horizontal (2F) Position Welds

1. PT/Laboratory

Have trainees practice using GMAW (spray and/or short-circuit transfer) and FCAW equipment, filler wire, and shielding gases to make multiple-pass fillet welds on carbon steel plate coupons in the 2F position. This laboratory corresponds to Performance Tasks 1, 2, and 5.

C. Vertical (3F) Position Welds

1. PT/Laboratory

Have trainees practice using GMAW (spray and/or short-circuit transfer) and FCAW equipment, filler metals, and shielding gases to make multiple-pass fillet welds on carbon steel plate coupons in the 3F position. This laboratory corresponds to Performance Tasks 1 and 2.

D. Overhead (4F) Position Welds

1. PT/Laboratory

Have trainees practice using GMAW (spray and/or short-circuit transfer) and FCAW equipment, filler wire, and shielding gases to make multiple-pass fillet welds on carbon steel plate coupons in the 4F position. This laboratory corresponds to Performance Tasks 1 and 2.

Sessions XVI–XXVII. Open V-Groove Welds

A. Open V-Groove Welds

1. Root Pass

2. Groove Weld Positions

3. Acceptable and Unacceptable Groove Weld Profiles

B. Practicing 1G, 2G, 3G, and 4G V-Groove Welds

1. PT/Laboratory

Have trainees practice using GMAW (spray and/or short-circuit transfer) and FCAW equipment, filler metals, and shielding gases to make multiple-pass V-groove welds on carbon steel plate coupons (with or without backing) in the 1G position. This laboratory corresponds to Performance Tasks 3, 4, and 6.

2. PT/Laboratory

Have trainees practice using GMAW (spray and/or short-circuit transfer) and FCAW equipment, filler wire, and shielding gases to make multiple-pass V-groove welds on carbon steel plate coupons (with or without backing) in the 2G position. This laboratory corresponds to Performance Tasks 3 and 4.

3. PT/Laboratory

Have trainees practice using GMAW (spray and/or short-circuit transfer) and FCAW equipment, filler wire, and shielding gases to make multiple-pass V-groove welds on carbon steel plate coupons (with or without backing) in the 3G position. This laboratory corresponds to Performance Tasks 3 and 4.

4. PT/Laboratory

Have trainees practice using GMAW (spray and/or short-circuit transfer) and FCAW equipment, filler wire, and shielding gases to make multiple-pass V-groove welds on carbon steel plate coupons (with or without backing) in the 4G position. This laboratory corresponds to Performance Tasks 3 and 4.

Session XXVIII. Review and Testing

A. Review

B. Module Examination

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

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

C. Performance Testing

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

Sessions XXIX–XXXII. Performance Accreditation Tasks

A. Performance Accreditation Tasks

Have trainees complete PAT 1 through PAT 8, according to the acceptance criteria.

1. Have trainees perform PAT 1, Make a Fillet Weld in the (1F) Flat Position. This task corresponds to *AWS EG2.0*, Module 5, Gas Metal Arc Welding (GMAW-S, GMAW), Key Indicators 5 and 7, and Module 6, Flux-Cored Arc Welding (FCAW-G, FCAW), Key Indicators 5, 7, 10, and 12.
2. Have trainees perform PAT 2, Make a Fillet Weld in the (2F) Horizontal Position. This task corresponds to *AWS EG2.0*, Module 5, Gas Metal Arc Welding (GMAW-S, GMAW), Key Indicators 5 and 7, and Module 6, Flux-Cored Arc Welding (FCAW-G, FCAW), Key Indicators 5, 7, 10, and 12.
3. Have trainees perform PAT 3, Make a Fillet Weld in the (3F) Vertical Position. This task corresponds to *AWS EG2.0*, Module 5, Gas Metal Arc Welding (GMAW-S, GMAW), Key Indicators 5 and 7, and Module 6, Flux-Cored Arc Welding (FCAW-G, FCAW), Key Indicators 5, 7, 10, and 12.
4. Have trainees perform PAT 4, Make a Fillet Weld in the (4F) Overhead Position. This task corresponds to *AWS EG2.0*, Module 5, Gas Metal Arc Welding (GMAW-S, GMAW), Key Indicators 5 and 7, and Module 6, Flux-Cored Arc Welding (FCAW-G, FCAW), Key Indicators 5, 7, 10, and 12.
5. Have trainees perform PAT 5, Make a Groove Weld, with or without Backing, in the (1G) Flat Position. This task corresponds to *AWS EG2.0*, Module 5, Gas Metal Arc Welding (GMAW-S, GMAW), Key Indicators 6 and 11, and Module 6, Flux-Cored Arc Welding (FCAW-G, FCAW), Key Indicators 6 and 11.
6. Have trainees perform PAT 6, Make a Groove Weld, with or without Backing, in the (2G) Horizontal Position. This task corresponds to *AWS EG2.0*, Module 5, Gas Metal Arc Welding (GMAW-S, GMAW), Key Indicators 6 and 11, and Module 6, Flux-Cored Arc Welding (FCAW-G, FCAW), Key Indicators 6 and 11.
7. Have trainees perform PAT 7, Make a Groove Weld, with or without Backing, in the (3G) Vertical Position. This task corresponds to *AWS EG2.0*, Module 5, Gas Metal Arc Welding (GMAW-S, GMAW), Key Indicators 6 and 11, and Module 6, Flux-Cored Arc Welding (FCAW-G, FCAW), Key Indicators 6 and 11.
8. Have trainees perform PAT 8, Make a Groove Weld, with or without Backing, in the (4G) Overhead Position. This task corresponds to *AWS EG2.0*, Module 5, Gas Metal Arc Welding (GMAW-S, GMAW), Key Indicators 6 and 11, and Module 6, Flux-Cored Arc Welding (FCAW-G, FCAW), Key Indicators 6 and 11.

Physical Characteristics and Mechanical Properties of Metal

Annotated Instructor's Guide

Module 29203-09

Module Overview

This module covers the physical characteristics, mechanical properties, composition, and classification of common ferrous and nonferrous metals. Various standard forms and structural shapes of metals are described, as well as methods used to identify metals.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Maritime Industry Fundamentals*; *Maritime Structural Fitter Level One*; and *Maritime Structural Fitter Level Two*.

Objectives

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

1. Identify and explain the composition and classification of base metals.
2. Explain and demonstrate field identification methods for base metals.
3. Identify and explain the physical characteristics and mechanical properties of metals.
4. Identify and explain forms and shapes of structural metals.
5. Explain metallurgical considerations for welding metals.

Performance Tasks

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

Materials and Equipment List

Markers/chalk	Pictures or examples of labeled metals
Pencils and scratch paper	Different types of steels, including high-strength low-alloy steels
Whiteboard/chalkboard	Various ferrous and nonferrous metals and filler metals
<i>Structural Fitter Level Three</i> PowerPoint® Presentation Slides can be downloaded (with your access code) from www.nccerirc.com	Samples of each type of structural steel
Multimedia projector and screen	Standard steel pipe samples
Desktop or laptop computer	Rebar with grade markings
Copies of steel classifications from AISI, ASTM International, and/or UNS	Metal samples to examine and identify by appearance and by magnet
AISI/SAE numbers of common carbon steels for identification purposes	Magnet
Pictures of wrecked racecars	Metal analyzer
Samples of mill markings on metals	Hardness testers
	Module Examinations*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Additional Resources

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

AWS B1.10:1999 *Guide for the Nondestructive Examination of Welds*. Miami, FL: American Welding Society.
 AWS B1.11:2000 *Guide for the Visual Examination of Welds*. Miami, FL: American Welding Society.
 AWS D3.5-93R *Guide for Steel Hull Welding*. Miami, FL: American Welding Society, 1993.
 AWS D3.6M:1999 *Specification for Underwater Welding*. Miami, FL: American Welding Society.
 AWS D3.7:2004 *Guide for Aluminum Hull Welding*. Miami, FL: American Welding Society.
 Lincoln Electric website: <http://www.lincolnelectric.com> offers sources for products and training.
Machinery's Handbook. Erik Oberg, Franklin D. Jones, and Christopher J. McCauley. New York, NY: Industrial Press, Inc., 2008.
Metals and How to Weld Them. T. B. Jefferson. Cleveland, OH: The James F. Lincoln Arc Welding Foundation.
 OSHA Standard 1926.351, *Arc Welding and Cutting*.
Stick Electrode Product Catalog. Cleveland, OH: The Lincoln Electric Company, 2008.
Stick Electrode Welding Guide. Cleveland, OH: The Lincoln Electric Company, 2004.
The Procedure Handbook of Arc Welding. 14th ed. Cleveland, OH: The James F. Lincoln Welding Foundation, 2000.
Welding Handbook. 4 vols. Miami, FL: American Welding Society.

Teaching Time for this Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 7½ hours are suggested to cover *Physical Characteristics and Mechanical Properties of Metals*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	Planned Time
Session I. Introduction; Metal Composition, Classifications, and Identification	
A. Introduction	_____
B. Metal Composition and Classifications	_____
1. Ferrous Metal	_____
2. Low-Alloy Steel	_____
3. Common Grade Stainless Steel	_____
4. Specialty Grade Stainless Steel	_____
5. Nonferrous Metals	_____
C. Field Identification of Base Metals	_____
1. Metal Labeling	_____
2. Identification by Magnet	_____
3. Identification by Appearance	_____
4. Identification by X-Ray Fluorescence Spectrometry	_____
Session II. Characteristics and Properties of Metals; Structural Steel and Common Milled Shapes	
A. Physical Characteristics of Metals	_____
1. Density	_____
2. Electrical Conductivity	_____
3. Thermal Conductivity	_____
4. Thermal Expansion	_____
5. Melting Point	_____
6. Corrosion Resistance	_____

B. Mechanical Properties of Metals

1. Stress-Strain Relationship
2. Elasticity and Elastic Limit
3. Modulus of Elasticity
4. Tensile Strength
5. Ductility
6. Hardness

C. Structural Steel and Common Milled Shapes

1. Plate, Sheet Metal, Bars, Angles, and Channels
2. Beams and Shapes from Beams
3. Pipe, Reinforcing Bars, and Tubing
4. Seamed and Seamless Tubing and Pipe
5. Forged Shapes, Cast Shapes, and Powdered Metals

Session III. Metallurgical Considerations for Welding; Review and Testing

A. Metallurgical Considerations for Welding

1. Base Metal Preparations
2. Joint Design
3. Filler Metal and Electrode Selection
4. Preheating and Interpass Temperature Control
5. Postweld Heat Treatment

B. Review

C. Module Examination

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

Module Overview

Today's leaders face a complex and challenging workforce, and having a capable leader is essential to the success of any team. This module introduces the trainee to the principles of leadership. Trainees will learn about:

- The construction industry today
- Business organizations
- Team building
- Gender and minority issues
- Communication
- Motivation
- Problem solving
- Decision making
- Safety
- Project control

Prerequisites

There are no prerequisites for this course.

Objectives

Upon completion of this course, the trainee will be able to:

1. Discuss current issues and organizational structure in industry today.
2. Understand and incorporate leadership skills into work habits, including communications, motivation, team building, problem solving, and decision-making skills.
3. Demonstrate an awareness of safety issues, including the cost of accidents and safety regulations.
4. Identify a crew leader's typical safety responsibilities.
5. Show a basic understanding of the planning process, scheduling, and cost and resource control.

Performance Tasks

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

1. Develop an estimate for a given work activity.
2. Develop and present a look-ahead schedule.

Note to Instructors

If you are training under an Accredited NCCER Sponsor, note that you may be eligible for dual credentials for successful completion of *Fundamentals of Crew Leadership*. When submitting the Form 200, indicate completion of the two module numbers that apply to *Fundamentals of Crew Leadership – 46101-11* (from NCCER's Management Series) and the applicable craft module (if used as part of a craft training program) and transcripts will be issued to you accordingly.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Maritime Structural Fitter Level Three PowerPoint®
Presentation Slides can be downloaded (with your access code) from www.nccerirc.com
Multimedia projector and screen
Computer
Several construction job descriptions, including one that is very vague and one that is overly detailed
Several MSDSs appropriate to the craft
Original and as-built drawings of the same project
A redline drawing
Sufficient copies of a roofing formwork detail drawing
Sufficient copies of the worksheet with entries

Examples of schedules:*
Bar chart
Network schedule
Short-term or look-ahead schedule
Two or three typical job schedules
Two job plans and pictures of each site
Construction drawings of a work platform with a concrete footing, including specifications, to be built on site:
Materials cost list including lumber, concrete, and hardware
Labor cost list including concrete finishers, carpenters, and masonry workers
Photographs of the planned site
Set of construction drawings
Module Examinations**
Performance Profile Sheets**

* Because this module may be used for different industries, materials such as project schedules should be appropriate to the craft where possible.

**Single-module AIG purchases include the printed exam and Performance Profile Sheets. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Additional Resources

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

Aging Workforce News, www.agingworkforcenews.com.

American Society for Training and Development (ASTD), www.astd.org.

Architecture, Engineering, and Construction Industry (AEC), www.aecinfo.com.

CIT Group, www.citgroup.com.

Equal Employment Opportunity Commission (EEOC), www.eeoc.gov.

National Association of Women in Construction (NAWIC), www.nawic.org.

National Census of Fatal Occupational Injuries (NCFOSI), www.bls.gov.

National Center for Construction Education and Research, www.nccer.org.

National Institute of Occupational Safety and Health (NIOSH), www.cdc.gov/niosh.

National Safety Council, www.nsc.org.

NCCER Publications:

- *Your Role in the Green Environment*
- *Sustainable Construction Supervisor*

Occupational Safety and Health Administration (OSHA), www.osha.gov.

Society for Human Resources Management (SHRM), www.shrm.org.

United States Census Bureau, www.census.gov.

United States Department of Labor, www.dol.gov.

USA Today, www.usatoday.com.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. This course is designed to be taught in one of two formats: two 8-hour sessions (such as all-day workshops) or eight 2-hour sessions (such as after-work training seminars). Because of this, each session below has a suggested time period of two hours. If leading 8-hour sessions, simply teach four of these 2-hour sessions both times your class meets. All instructors will need to adjust the time required for participant activities and testing based on class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Section One – The Basics	
A. Industry Today	_____
1. The Need for Training	_____
2. Impact of Technology	_____
B. Gender and Cultural Issues	_____
1. Communication Styles of Men and Women	_____
2. Language Barriers	_____
3. Cultural Differences	_____
4. Sexual Harassment	_____
5. Gender and Minority Discrimination	_____
C. Business Organizations	_____
1. Division of Responsibility	_____
2. Authority, Responsibility, and Accountability	_____
3. Job Descriptions	_____
4. Policies and Procedures	_____
Session II. Section Two – Leadership Skills, Part One	
A. Introduction to Leadership	_____
B. The Shift in Work Activities	_____
C. Becoming a Leader	_____
1. Characteristics of a Leader	_____
2. Functions of a Leader	_____
3. Leadership Styles	_____
4. Ethics in Leadership	_____
D. Communication	_____
1. Verbal Communication	_____
2. Nonverbal Communication	_____
3. Written or Visual Communication	_____
4. Communication Issues	_____
E. Motivation	_____
1. Employee Motivators	_____
2. Motivating Employees	_____
F. Team Building	_____
1. Successful Teams	_____
2. Building Successful Teams	_____

Session VI. Section Four – Project Control, Part Two

- A. Planning _____
 - 1. Why Plan? _____
 - 2. Stages of Planning _____
- B. PT/Laboratory _____

Have the trainees develop and present a look-ahead schedule based on one of the plans. This laboratory corresponds to Performance Task 2.
- C. The Planning Process _____
 - 1. Establish a Goal _____
 - 2. Identify the Work to Be Done _____
 - 3. Identify Tasks to Be Performed _____
 - 4. Communicating Responsibilities _____
 - 5. Follow-Up Activities _____
- D. Planning Resources _____
 - 1. Safety Planning _____
 - 2. Materials Planning _____
 - 3. Site Planning _____
 - 4. Equipment Planning _____
 - 5. Tool Planning _____
 - 6. Labor Planning _____

Session VII. Section Four – Project Control, Part Three

- A. Scheduling _____
 - 1. The Scheduling Process _____
 - 2. Bar Chart Schedule _____
 - 3. Network Schedule _____
 - 4. Short-Term Scheduling _____
 - 5. Updating a Schedule _____
- B. Cost Control _____
 - 1. Assessing Cost Performance _____
 - 2. Field Reporting System _____
 - 3. Crew Leader’s Role in Cost Control _____
- C. Resource Control _____
 - 1. Materials Control _____
 - 2. Equipment Control _____
 - 3. Tool Control _____
 - 4. Labor Control _____
- D. Production and Productivity _____

Session VIII. Review; Testing

- A. Module Review _____
- B. Module Examination _____
 - 1. Trainees must score 70 percent or higher to receive recognition from NCCER.
 - 2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.
- C. Performance Testing _____
 - 1. Trainee must perform each task to the satisfaction of the instructor to receive recognition from NCCER.
 - 2. Record the training results on Training Report Form 200, and submit the results to the Training Program Sponsor.