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.


### 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.

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<th>Topic</th>
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<td>1. General Arrangement Drawings</td>
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<td>Sessions III through VIII. Working With Drawings</td>
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<td>A. Working With Drawings</td>
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<td>1. Assembly Drawings</td>
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<td>2. Foundation Drawings</td>
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<td>3. Mechanical Drawings</td>
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<td>4. Doors, Scuttles, and Hatches</td>
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<td>Sessions IX through XII. PT/Laboratory</td>
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<tr>
<td>A. PT/Laboratory</td>
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<tr>
<td>1. Have trainees lay out work lines for various structures. This laboratory corresponds to Performance Task 1.</td>
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<td>Sessions XIII through XV. Drawing Change Control</td>
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<td>A. Drawing Change Control</td>
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<td>1. Configuration Control</td>
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<td>2. Retrofits</td>
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</table>
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.

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.

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<th>Topic</th>
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<td>Sessions I and II. Introduction and Layout</td>
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<td>A. Introduction</td>
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<td>1. Safety Review</td>
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<td>B. Layout</td>
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<td>1. Layout Tools</td>
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<td>2. Layout Tasks</td>
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<tr>
<td>Sessions III through X. PT/Laboratory</td>
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<tr>
<td>A. PT/Laboratory</td>
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<tr>
<td>1. Have trainees lay out bulkhead and deck penetrations, and door openings. This laboratory corresponds to Performance Tasks 1 and 2.</td>
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<tr>
<td>Sessions XI through XIII. Fitting Tasks</td>
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<td>A. Fitting Tasks</td>
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<td>1. Installing Stiffening Members</td>
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<td>2. Fitting a Frame Over Stiffeners</td>
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<td>3. Installing Shell Plating</td>
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<td>4. Building and Setting a Foundation</td>
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<tr>
<td>5. Installing a Watertight Door</td>
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<td>6. Joiner Doors</td>
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<td>7. Hatches</td>
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<td>8. Installing a Bulkhead</td>
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<td>9. Pulling Sheerstrake to a Deck</td>
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<tr>
<td>Sessions XIV through XIX. PT/Laboratory</td>
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<tr>
<td>A. PT/Laboratory</td>
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<tr>
<td>1. Have trainees lay out, build, and install a simple foundation. This laboratory corresponds to Performance Task 3.</td>
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</tbody>
</table>
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.
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
Pencils and scratch paper
Whiteboard/chalkboard
Structural Fitter Level Three PowerPoint®
   Presentation Slides can be downloaded (with your access code) from www.nccerirc.com
Multimedia projector and screen
Desk or laptop computer
Appropriate personal protective equipment
Engine-driven power source
Inverter power source
Welding cable
Lugs and quick disconnects
Wire feeders
Wire straighteners
GMAW/FCAW-G guns
Shielding gas regulators/flowmeters
Labeled samples of GMAW/FCAW filler wire
   in various types and sizes
Electrical plugs and outlets
Workpiece clamps
Manufacturer’s instruction manual for an engine-driven generator
Leather welding gloves
Leather welding jacket or sleeves
Welding shield or helmet
Selection of shades 5 to 14 tinted lenses
Cutting goggles
FCAW welding equipment
Electrode wire, 0.45” dual shielded flux-cored carbon steel
GMAW welding equipment
Carbon steel wire electrode
Shielding gas
Welding bench with arm for position work
Portable angle-head grinders
Framing square
Soapstone
Tape measure
Pliers
Half-round bastard file

continued
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.

Lincoln Electric website: http://www.lincolnelectric.com offers sources for products and training.

Teaching Time for this Module

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

<table>
<thead>
<tr>
<th>Topic</th>
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<td>B. Safety Practices</td>
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<td>C. Characteristics of Welding Current</td>
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<td>E. GMAW and FCAW Equipment</td>
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<td>1. GMAW Metal Transfer Modes</td>
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<td>2. FCAW Metal Transfer Process</td>
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<td>3. GMAW Power Sources</td>
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<td>4. Welding Cable</td>
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<td>5. External Wire Feeders</td>
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<td>6. GMAW/FCAW-G Guns</td>
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<td>7. FCAW-S Guns</td>
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<td>8. Shielding Gas Supply</td>
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</table>
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
- Pencils and scratch paper
- Whiteboard/chalkboard
- Structural Fitter Level Three PowerPoint® (Presentation Slides can be downloaded (with your access code) from www.nccerirc.com)
- Multimedia projector and screen
- Desktop or laptop computer
- Appropriate personal protective equipment
- FCAW welding equipment
- GMAW welding equipment
- Shielding gas
- Flux-cored wire
- Solid or composite wire
- Backing materials
- Plate steel for coupons, 3/16” to 3/8”
- Welding bench with arm for position work
- Portable angle-head grinders with extra grinding discs
- Anti-splatter material
- MSDS for each cleaning agent used
- Bevel gauge(s)
- Framing square
- Soapstone
- Tape measure
- Pliers
- Half-round bastard file
- Wire brush
- Chipping hammer
- Workpiece clamps
- Examples of the following:
  - Beads created with different travel speed settings
  - Good and bad weld beads
  - Stringer beads
  - Weave beads
  - Properly and improperly terminated welds
  - Proper and improper overlapping beads
  - Pads made using stringer and weave beads
  - Fillet welds from all four welding positions
  - Fillet welds that have been sawed to expose their profiles
  - Ground and unground root passes
  - Broken apart open V-groove root pass weld
- 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.

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.

- **E1.10 2009 Product Catalog.** Cleveland, OH: The Lincoln Electric Company.
## 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.

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<tr>
<td>A. Introduction</td>
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<td>1. The GMAW Process</td>
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<td>2. The FCAW Process</td>
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<td>3. GMAW and FCAW Equipment</td>
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<td>B. Welding Safety</td>
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<td>1. Protective Clothing and Equipment</td>
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<td>2. Fire/Explosion Prevention</td>
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<td>3. Work Area Ventilation</td>
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<tr>
<td>C. Welding Equipment Setup</td>
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<td>1. Preparing the Welding Area</td>
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<td>2. Preparing the Practice Coupons</td>
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<td>3. Welding Machine</td>
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<td>4. Welding Voltage, Amperage, and Travel Speed</td>
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<td>5. Gun Position</td>
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<td>6. Electrode Extension, Stickout, and Standoff Distance</td>
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<td>7. Gas Nozzle Cleaning</td>
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<tr>
<td>D. Laboratory</td>
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<tr>
<td>Have trainees set up the welding area and prepare plate coupons for GMAW and FCAW fillet and groove welds.</td>
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<tr>
<td><strong>Sessions II–III. Bead Types; Laboratory</strong></td>
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<td>A. Bead Types</td>
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<td>1. Stringer Beads</td>
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<td>2. Weave Beads</td>
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<td>3. Weld Restarts</td>
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<td>4. Weld Terminations</td>
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<td>5. Overlapping Beads</td>
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<tr>
<td>B. Laboratory</td>
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<tr>
<td>Have trainees set up GMAW and FCAW equipment and practice starting, restarting, and terminating beads; altering gun angles to see the effects on stringer and weave beads; and overlapping beads to build a pad.</td>
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<tr>
<td><strong>Sessions IV–XV. Fillet Welds</strong></td>
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<td>A. Flat (1F) Position Welds</td>
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<tr>
<td>1. PT/Laboratory</td>
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<tr>
<td>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.</td>
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</tbody>
</table>
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.
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  
Pencils and scratch paper  
Whiteboard/chalkboard  
Structural Fitter Level Three PowerPoint®  
Presentation Slides can be downloaded (with your access code) from www.nccerirc.com  
Multimedia projector and screen  
Desktop or laptop computer  
Copies of steel classifications from AISI, ASTM International, and/or UNS  
AISI/SAE numbers of common carbon steels for identification purposes  
Pictures of wrecked racecars  
Samples of mill markings on metals  
Pictures or examples of labeled metals  
Different types of steels, including high-strength low-alloy steels  
Various ferrous and nonferrous metals and filler metals  
Samples of each type of structural steel  
Standard steel pipe samples  
Rebar with grade markings  
Metal samples to examine and identify by appearance and by magnet  
Magnet  
Metal analyzer  
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.

Lincoln Electric website: http://www.lincolnelectric.com offers sources for products and training.
OSHA Standard 1926.351, Arc Welding and Cutting.

Teaching Time for this Module

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

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<tr>
<th>Topic</th>
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<td>4. Identification by X-Ray Fluorescence Spectrometry</td>
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<td>3. Thermal Conductivity</td>
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<td>4. Thermal Expansion</td>
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<td>5. Melting Point</td>
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<td>6. Corrosion Resistance</td>
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</table>
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](http://www.agingworkforcenews.com).
- CIT Group, [www.citgroup.com](http://www.citgroup.com).
- National Association of Women in Construction (NAWIC), [www.nawic.org](http://www.nawic.org).
- National Center for Construction Education and Research, [www.nccer.org](http://www.nccer.org).
- National Institute of Occupational Safety and Health (NIOSH), [www.cdc.gov/niosh](http://www.cdc.gov/niosh).
- NCCER Publications:
  - *Your Role in the Green Environment*
  - *Sustainable Construction Supervisor*
- Occupational Safety and Health Administration (OSHA), [www.osha.gov](http://www.osha.gov).
- Society for Human Resources Management (SHRM), [www.shrm.org](http://www.shrm.org).
- United States Census Bureau, [www.census.gov](http://www.census.gov).
- USA Today, [www.usatoday.com](http://www.usatoday.com).
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.

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<td>C. Business Organizations</td>
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<td>D. Communication</td>
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<td>3. Written or Visual Communication</td>
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<td>F. Team Building</td>
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<td>1. Successful Teams</td>
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<td>2. Building Successful Teams</td>
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</table>
Session III. Section Two – Leadership Skills, Part Two; Section Three – Safety, Part One

A. Getting the Job Done
   1. Delegating
   2. Implementing Policies and Procedures

B. Problem Solving and Decision Making
   1. Decision Making vs. Problems Solving
   2. Types of Decisions
   3. Problem Solving
   4. Special Leadership Problems

C. Safety Overview
   1. Accident Statistics

D. Costs of Accidents
   1. Insured Costs
   2. Uninsured Costs

E. Safety Regulations
   1. Workplace Inspections
   2. Penalties for Violations

Session IV. Section Three – Safety, Part Two

A. Employer Safety Responsibilities
   1. Safety Program

B. Crew Leader Involvement in Safety
   1. Safety Training Sessions
   2. Inspections
   3. First Aid
   4. Fire Protection and Prevention
   5. Substance Abuse
   6. Job-Related Accident Investigations

C. Promoting Safety
   1. Safety Training Sessions
   2. Safety Contests
   3. Incentives and Awards
   4. Publicity

Session V. Section Four – Project Control, Part One

A. Project Control Overview
   1. Development Phase
   2. Planning Phase
   3. Construction Phase

B. Project Delivery Systems
   1. General Contracting
   2. Design-Build
   3. Construction Management

C. Cost Estimating and Budgeting
   1. The Estimating Process

D. PT/Laboratory
   Have the trainees develop an estimate for the work activity. This laboratory corresponds to Performance Task 1.
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.