SKILLEDTRADESBC

PROGRAM OUTLINE

Marine Fitter Endorsement

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SKILLED TRADES BC

MARINE FITTER ENDORSEMENT

PROGRAM OUTLINE

APPROVED BY INDUSTRY

MAY 2017

Developed by
SkilledTradesBC
Province of British Columbia

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Section 1

INTRODUCTION

Marine Fitter Endorsement

Foreword

This Program Outline is for use in Marine Fitter Endorsement training classes sponsored by SkilledTradesBC and will be used as a curriculum planning guide for instructors in the formal classroom portions of apprenticeship training.

Practical demonstration and student participation should always be integrated with classroom sessions.

Safe working practices, though not always specified in each of the competencies and learning tasks, are an implied part of the program and should be stressed throughout the apprenticeship.

Achievement Criteria set a common minimum standard for training providers to measure achievement of practical competencies. Achievement Criteria are included only for competencies that require a practical assessment. Where Achievement Criteria are specified, the apprentice must achieve the specifications, safety standards and timeframes described.

Competencies that are solely theory-based will be assessed through a multiple choice test(s) for which the apprentice must achieve a minimum score of 70%.

This Program Outline includes a list of recommended reference textbooks that are available to support the learning objectives and the minimum shop requirements needed to support instruction.

SAFETY ADVISORY

Be advised that references to the WorkSafe BC safety regulations contained within these materials do not/may not reflect the most recent Occupational Health and Safety Regulation (the current Standards and Regulation in BC can be obtained on the following website: http://www.worksafebc.com). Please note that it is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulation pertaining to his/her work.

Acknowledgements

The Marine Fitter program was developed from 2011 – 2017. During this time, Subject Matter Experts were convened to review and revise the BC Program Profile and Program Outline. The following are the Subject Matter Experts who participated in these reviews:

2017

- Brian Beasley, Seaspan Vancouver Shipyards
- Ken Crooks, Department of National Defense (DND)
- Ryan Fischer, Seaspan Victoria Shipyards
- Peter Thomas, BC Institute of Technology

2015

- Brian Beasley, Seaspan Vancouver Shipyards
- Tony DenOtter, Department of National Defense (DND)
- Ryan Fischer, Seaspan Victoria Shipyards
- Don Smith, BC Institute of Technology
- Peter Thomas, BC Institute of Technology

2013

- Ken Crooks, Department of National Defense (DND)
- Tony DenOtter, Department of National Defense (DND)
- Jim Fitzpatrick, Boilermakers Lodge #191
- Glen Gibson, Department of National Defense (DND)
- Merike Kolga, Seaspan
- Peter Lorimer, Seaspan
- David Meek, Camosun College
- John Taylor, Seaspan
- Garry Waugh, BC Ferry Corporation
- Dan Wood, Stonecoast Group

2011

- Steve Barnes, Vancouver Dry Dock
- Gordon Dearie, Victoria Shipyards
- Tony DenOtter, Department of National Defense (DND)
- Ryan Fischer, Seaspan Victoria Shipyards
- David Meek, Camosun College
- John Taylor, Vancouver Shipyards

SkilledTradesBC would like to acknowledge the dedication and hard work of all industry and training provider representatives appointed to identify the training requirements of the Marine Fitter endorsement.

How to Use this Document

This Program Outline has been developed for the use of individuals from several different audiences.

The table below describes how each section can be used by each intended audience.

Section	Training Providers	Employers/ Sponsors	Program Apprentices	Program Challengers
Program Credentialing Model	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program	Understand the length and structure of the program, and pathway to completion	Understand challenger pathway to Certificate of Qualification
OAC	Communicate the competencies that industry has defined as representing the scope of the occupation	Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification	View the competencies they will achieve as a result of program completion	Understand the competencies they must demonstrate in order to challenge the program
Training Topics and Suggested Time Allocation	Shows proportionate representation of various GACs at each program level; should map to proportions of time spent on training, practical experience, and assessment	Understand the relative scope of various areas of the occupation, and areas in which the apprentice would require on-the-job experience	Understand the relative scope of various areas of the occupation, and areas in which on-the-job experience would be provided	Understand the relative weightings of various areas of the occupation on which assessment is based
Program Outline	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measureable achievement criteria for objectives with a practical component	Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels
Training Provider Standards	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own	Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors	Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment

Section 2

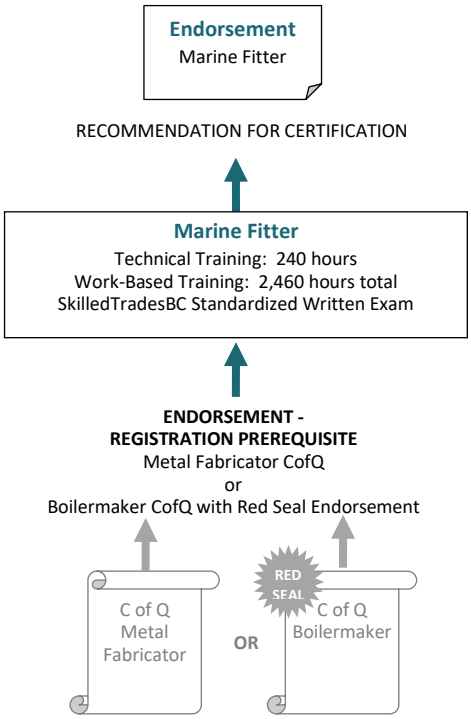
PROGRAM OVERVIEW

Marine Fitter Endorsement

Program Credentialing Model

Marine Fitter Endorsement (Optional)

This graphic provides an overview of the Marine Fitter post-certification endorsement.



Occupational Analysis Chart

MARINE FITTER

Occupation Description: Marine Fitters work in the Shipbuilding and Repair Industry to cut and fit metal plates and other components in the process of assembling, constructing and repairing large vessels.

UNDERSTAND THE SHIPBUILDING AND REPAIR INDUSTRY **A**	Identify shipbuilding processes A1 EN	Describe ship transfer A2 EN	Use marine industry terminology A3 EN
DEMONSTRATE SAFE WORK PRACTICES **B**	Identify safe work practices to shipyard environments B1 EN	Work safely in high hazard environments B2 EN	Apply safe rigging practices B3 EN
READ SHIP DRAWINGS **C**	Use construction drawings C1 EN	Use multiple drawing sets C2 EN	
CREATE LOFTS **D**	Apply the lofting process D1 EN	Develop an initial lines plan D2 EN	Refine an initial lines plan D3 EN	Proof a refined lines plan D4 EN
CONSTRUCT AND REPAIR SHIP STRUCTURES **E**	Use a jig in ship construction E1 EN	Assemble ship structures E2 EN	Outfit ships E3 EN	Erect hull blocks E4 EN	Repair ship structures E5 EN

Training Topics and Suggested Time Allocation

MARINE FITTER - ENDORSEMENT

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**UNDERSTAND THE SHIPBUILDING AND REPAIR INDUSTRY**	**21%**	100%	0%	100%
A1	Identify shipbuilding processes		✓		
A2	Describe ship transfer		✓		
A3	Use marine industry terminology		✓		
Line B	**DEMONSTRATE SAFE WORK PRACTICES**	**8%**	50%	50%	100%
B1	Identify safe work practices to shipyard environments		✓		
B2	Work safely in high hazard environments		✓	✓	
B3	Apply safe rigging practices		✓	✓	
Line C	**READ SHIP DRAWINGS**	**18%**	60%	40%	100%
C1	Use construction drawings		✓	✓	
C2	Use multiple drawing sets		✓	✓	
Line D	**CREATE LOFTS**	**25%**	10%	90%	100%
D1	Apply the lofting process		✓		
D2	Develop an initial lines plan		✓	✓	
D3	Refine an initial lines plan		✓	✓	
D4	Proof a refined lines plan		✓	✓	
Line E	**CONSTRUCT AND REPAIR SHIP STRUCTURES**	**28%**	10%	90%	100%
E1	Use a jig for use in ship construction		✓		
E2	Assemble ship structures		✓	✓	
E3	Outfit ships		✓	✓	
E4	Erect hull blocks		✓		
E5	Repair ship structures		✓		
	Total Percentage for Marine Fitter Endorsement	**100%**			

Section 3

PROGRAM CONTENT

Marine Fitter

Line (GAC): A UNDERSTAND THE SHIPBUILDING AND REPAIR INDUSTRY

Competency: A1 Identify shipbuilding processes

Objectives

To be competent in this area, the individual must be able to:

- Describe the work responsibilities and tasks of journeyperson marine fitters in a variety of work settings.
- Explain construction methods and processes used in the shipbuilding and repair industry.
- Identify and describe classification standards relevant to the shipbuilding and repair industry
- Clarify shipbuilding trades and responsibilities.

LEARNING TASKS	CONTENT
1. Describe the history of the Marine Fitter trade	• Platers • Shipbuilding in Canada/BC

2. Describe the scope of the Marine Fitter trade	• Docking ships
	• Hull construction
	• Installations equipment
	• Fitting out ships
	• Critical measurements
	• Apply ship construction standards
	• Quality control
	• Read drawings
	• Lofting
	• Shop equipment usage
	  ○ Brake press
	  ○ Shears
	  ○ Iron worker
	  ○ Welding
	• Rigging

3. Describe interaction with other trades and departments	• Rigging • Shipwrights • Engineering • Design • Technical services • Mechanical / engine fitters / machining • Pipefitting • Planning / estimating • Electrical • Welding • QC / QA
4. Describe construction methods and processes	• Manufacturing block and modular

LEARNING TASKS	CONTENT

used in the shipbuilding and repair industry	components vs. conventional shipbuilding
	• Product work breakdown structure (PWBS)
	• Production flow of a modern shipyard
	• Panel line overview and components
	  ○ Assembly and sub-assembly
	  ○ Modules
	  ○ Blocks
	  ○ Grand blocks
	  ○ Outfitting
	• Flat panel, curved panel pre-outfitting, outfitting, erection

5. Identify classification societies providing standards for the shipbuilding and repair industry	• SNAME (Society of Naval Architects and Marine Engineers) • IACS (International Association of Classification Societies) • Lloyds Register Marine • BV (Bureau Veritas) • ISO (International Organization for Standardization) • Canadian Welding Bureau • American Welding Society • Transport Canada • ABS (American Bureau of Shipping) • DNV (Det Norske Veritas) • ASME (American Society of Mechanical Engineers)

6. Describe roles and responsibilities of classification societies	• Worker
	  ○ Foreman
	  ○ Charge hand
	  ○ Manager
	• Inspector
	• Marine surveyor
	• Naval architect
	• Marine engineer
	• Quality Assurance inspectors
	• Standards & Measurement personnel

7. Describe survey type and frequency	• Annual, 3 year & 5 year survey • Special
8. Describe materials classification as it relates to IACS	• Steel plate • Steel structural members

Line (GAC): A UNDERSTAND THE SHIPBUILDING AND REPAIR INDUSTRY

Competency: A2 Describe ship transfer

Objectives

To be competent in this area, the individual must be able to:

- Describe ship launching systems.
- Describe ship transport systems.
- Describe the ship docking/undocking process.

LEARNING TASKS	CONTENT

1. Describe ship launching systems	• Side launch
	• Marine railway
	• Synchro lift
	• Slipway
	• Floating dry dock
	  ○ Capstan
	• Graving dock
	  ○ Capstan
	• Tide grid

2. Describe ship transport systems	• Self-Propelled Modular Transporter (SPMT) • Cradle • Railway • Turntable • Travel lift • Trailer

3. Describe docking/undocking a vessel	• Roles and responsibilities
	  ○ Dock Master
	  – Docking plan
	  – Coordination
	  ○ Naval architects
	  ○ Engineers
	  ○ Shipwrights
	  ○ Divers
	  ○ Rigging crew
	  ○ Pilots
	  ○ Tugs
	• Safety procedures
	• Environmental
	• Blocks
	  ○ Placement

LEARNING TASKS	CONTENT
	– Hull appendage ○ Setting ○ Design ○ Types

Line (GAC): A UNDERSTAND THE SHIPBUILDING AND REPAIR INDUSTRY

Competency: A3 Use marine industry terminology

Objectives

To be competent in this area, the individual must be able to:

- Identify ship terms.

LEARNING TASKS	CONTENT

1. Identify ship terms	• Parts of a ship
	  ○ Primary
	  ○ Secondary
	• Areas of a ship
	• Locations
	• Directions
	• Ship specifications
	  ○ Breadth
	  ○ LOA
	  ○ Draft
	  ○ Freeboard
	• Safety equipment
	• Tools/Equipment
	• Staff/Personnel
	• Processes
	  ○ Lofting
	  ○ Part production
	  ○ Machinery
	  ○ Departments

Line (GAC): B DEMONSTRATE SAFE WORK PRACTICES

Competency: B1 Identify safe work practices to shipyard environments

Objectives

To be competent in this area, the individual must be able to:

- Describe Canada Labour Code and WorkSafeBC regulations specifically related to hazards in the shipbuilding and repair industry and to marine fitter work in particular.
- Describe safe work practices for workplaces in the shipbuilding and repair industry.

LEARNING TASKS	CONTENT
1. Describe federal and provincial regulations specific to the shipbuilding and repair industry	• Canada Labour Code Part 2 • WorkSafeBC regulations • Occupational Safety and Health Association (OSHA)

2. Identify industry specific safe work practices	• Confined space entry
	• Hotwork
	• Work hazard assessment
	• Toolbox talk (safety meeting)
	• Field Level Risk Assessment (FLRA)
	• Radiation hazards (Rad Haz)
	• Lockout procedures
	• Fall arrest
	• Man aloft (and extraction)
	• Flotation
	• Ship staff
	  ○ Coordination
	  ○ Roles and responsibilities
	  ○ General liaison
	  ○ Documentation

3. Describe permits	• Hot work • Confined space • Work Aloft • Rad Haz

Line (GAC): B DEMONSTRATE SAFE WORK PRACTICES

Competency: B2 Work safely in high hazard environments

Objectives

To be competent in this area, the individual must be able to:

- Describe requirements for protective equipment in the shipbuilding and repair industry.
- Use protective equipment in shipbuilding and repair industry workplaces.

LEARNING TASKS	CONTENT
1. Recognize hazards	• Lead • Asbestos • Respiratory hazards • Lead-based paints • Protective equipment
2. Describe protective equipment unique to shipbuilding and repair industry	• Respirators • Air fed • Fall arrest • Hazmat suits • Personal flotation devices
3. Apply procedures for working in high hazard environments	• WHMIS 2015 • Safe Working Practices (SWP) • Safe Operating Procedures (SOP) • Field Level Risk Assessment (FLRA) • Environmental and Job Hazard Analysis • Tool box talk

Achievement Criteria

Performance — The learner will be able to select, inspect and use appropriate protective equipment for high hazard environments.

Conditions — The learner will be given:

- A simulated hazardous workplace
- PPE

Criteria — The learner will be evaluated on:

- Correct hazard identification
- Select appropriate protective equipment and workplace procedures
- Use equipment correctly

Line (GAC): B DEMONSTRATE SAFE WORK PRACTICES

Competency: B3 Apply safe rigging practices

Objectives

To be competent in this area, the individual must be able to:

- Identify the safe procedures and equipment required to execute a lift
- Develop a lift plan
- Describe safe use of slings and attachments.
- Identify appropriate rigging configurations and safe rigging approaches.
- Identify correct load calculations.

LEARNING TASKS	CONTENT

1. Identify rigging equipment	• Slings
	• Attachments
	  ○ Plate grabs
	  ○ Spreader beams

2. Develop a lift plan/plan a lift	• Safety factors
	• Equipment inspection
	• Load calculations
	• Centre of balance
	• Communication
	  ○ Hand signals
	  ○ Radios
	• Swing control
	• Load transit
	• Crane operation
	• Coordination with drop point

3. Hoist a load	• Centered • Off-Centered • Balanced load • Unbalanced load

Achievement Criteria

Performance The learner will be able to plan and conduct the lift of an asymmetric load.

Conditions The learner will be given:

- An overhead crane
- Rigging equipment
- An asymmetric load
- PPE

Criteria

The learner will be evaluated on:

- Demonstration of a controlled lift
- Safe material handling
- Work safely and in a professional manner

Line (GAC): C READ SHIP DRAWINGS

Competency: C1 Use construction drawings

Objectives

To be competent in this area, the individual must be able to:

- Describe the purpose and applications of drawings in the shipbuilding and repair industry.
- Use drawings to fabricate a component.

LEARNING TASKS	CONTENT

1. Describe types of drawings used in shipbuilding and repair	• Drawing orientation
	  ○ Deck
	  ○ Section
	  ○ Lines
	  ○ Construction
	• Arrangements
	• Work packages
	  ○ Detail drawing
	  ○ Assembly drawing
	  ○ Assembly sequence
	• Shell expansion plan

2. Identify key components of drawings	• Marine symbols
	  ○ Mid-ship
	  ○ Plimsoll
	  ○ Sub-surface hazards
	  ○ Stability marks
	  ○ Tug areas
	• Terminology

3. Use drawings to fabricate a component	• Specifications • Standards (IACS) • Fabrication sequence • Interference • Layout • Materials ○ Associated marine structural shapes

Achievement Criteria

Performance: The learner will be able to use a simple drawing to fabricate an outfitting component.

Conditions: The learner will be given:

- Ship construction drawing
- Materials
- 1/4” (6 mm) steel plate (or heavier)
- Shop space
- Shop equipment
- Material handling equipment

- Shop tools
- 12 hours to fabricate an outfitting component

Criteria

The learner will be evaluated on:

- Consistency of faying surface (gaps less than 3/16" or 5 mm)
- Profile/forming
- Codes and standards
  - Finish
  - Accuracy
  - Tolerances to 1/16" (2 mm)
  - Welding
  - Distortion
  - Alignment
- Safe material handling
- Work safely and in a professional manner
- Labeling

Line (GAC): C READ SHIP DRAWINGS

Competency: C2 Use multiple drawing sets

Objectives

To be competent in this area, the individual must be able to:

- Use multiple drawing sets to illustrate advanced components.
- Layout an advanced hull structure.

LEARNING TASKS	CONTENT

1. Identify key components of multiple drawings	• Marine symbols
	• Marine terminology
	• Dimensions (Table of Offset vs. Conventional)
	• Materials identification in drawings
	• Standard drawing information
	  ○ Legend
	  ○ Title block
	• Cut aways
	• Section views
	• Specs table

2. Use multiple drawing sets	• Table of specifications
	• Workflow
	  ○ Fabrication sequence
	  ○ Installation requirements
	  ○ Interference
	• Sub-assembly
	• Layout
	• Patterns
	• Jigs
	• Materials
	• Equipment

3. Interpret a lines plan	• Construction drawings • General arrangement drawings • Structural attachments • Structural configuration • Weld considerations • Relevant angles • Joint configurations • Coordinate reference • Moulded line policy • Frame spacing

LEARNING TASKS	CONTENT
4. Develop a shop drawing (flat pattern layout)	• Structural member

Achievement Criteria

Performance — The learner will be able to develop and layout an accurate 12' × 14' (3.6 m × 4.2 m) steel structural component for subsequent fabrication.

Conditions — The learner will be given:

- Multiple drawing sets
- Materials
- Shop space
- Shop tools

Criteria — The learner will be evaluated on the required offsets for component, including:

- Keel location
- Chine location
- Water lines
- Deck at side
- Deck at centre
- Deck camber
- Mitre angles
- Dead rise
- Datum lines
- Relevant marks
- Code and specification

Line (GAC): D CREATE LOFTS

Competency: D1 Apply the lofting process

Objectives

To be competent in this area, the individual must be able to:

- Identify the hull development process.

LEARNING TASKS	CONTENT
1. Describe planning for the space requirements for lofting	• Plan space for lofting • Scale • Working room • Lighting • Tool and equipment access • Light colour, smooth, flat floor • Large access doors
2. Describe the selection of tools and processes	• Three-sided scale • Various flexible battens • T-Square • Bevel square • Table of offsets • Scrieve board • Faired curves
3. Describe a table of offsets	• 3 dimensional coordinate system • Hull surface points (feet, inches and eighths) • Moulded line policy • Calculations
4. Identify the principle views used in lofting	• Profile • Half-breadth • Body line
5. Identify essential lofting lines	• Baseline • Stations • Waterlines • Profile • Rabbet • Buttock • Diagonal • Forward/aft perpendicular

LEARNING TASKS	CONTENT
6. Identify codes and specifications	• Fairing lines • Accuracy • Tolerances

Line (GAC): D CREATE LOFTS

Competency: D2 Develop an initial lines plan

Objectives

To be competent in this area, the individual must be able to:

- Develop the essential lofted views for a vessel.
- Label all lines and points in the views.

LEARNING TASKS	CONTENT
1. Apply a table of offsets	• Hull surface points (feet, inches and eighths) • Metric • Imperial • Scaled • Moulded line
2. Develop a profile plan	• Stations • Keel • Datum/baseline • Forward perpendicular • Aft perpendicular • Mid-ships • Water lines • Rabbet • Buttocks
3. Develop a half-breadth plan	• Stations • Water lines • Offsets • Rabbet • Diagonal
4. Develop body plan	• Water lines • Centre line • Sheer line • Rabbet • Buttocks • Diagonal
5. Label all lines and points in the views	• Water lines • Centre line • Mid-ships • Baseline • Deck at side (D@S) • Deck at centre line (D@CL)

LEARNING TASKS	CONTENT
	• Rabbet • Terminology

Achievement Criteria

Performance — The learner will be able to develop the initial lines for a 50' (15.2 m) steel vessel.

Conditions — The learner will be given:

- Drawings
- Table of offsets
- Loft space
- Equipment
- Materials

Criteria — The learner will be evaluated on:

- Completion of the three essential views within a 24 hour period
- Accuracy within 1/16" (2 mm)
- Work safely and in a professional manner

NOTE: It is suggested that this is a paired task to achieve the drawing and fairing requirements.

Line (GAC): D CREATE LOFTS

Competency: D3 Refine an initial lines plan

Objectives

To be competent in this area, the individual must be able to:

- Refine a hull form.
- Use applicable terminology.

LEARNING TASKS	CONTENT
1. Apply frame locations	• Frame spacing • Watertight bulkheads • Collision bulkheads

2. Apply buttock locations	• Standard spacing
	• Complex geometry
	  ○ Bow
	  ○ Stern
	  ○ Thruster locations
	  ○ Through hulls
	  ○ Sea chests

3. Apply water line locations	• Design water line (DWL) • Deck locations • Spacing
4. Develop refined lines	• Faired curves • Flat spots • Tangency • Critical thinking • Codes and standards • Accuracy • Neatness
5. Describe roll line	• Direction • Grain • Transition • Process • Expansion/contraction • Sweeps and patterns • Tools and equipment

Achievement Criteria

Performance — The learner will be able to develop a refined lines plan for a 50' (15.2 m) steel vessel.

Conditions — The learner will be given:

- An initial lines plan
- Table of offsets
- Loft space
- Tools & materials
- 24 hours to complete task

Criteria — The learner will be evaluated on:

- Faired hull form within standards specified from initial lines plan
  - Minimal flat spots
  - Consistent curves
  - Consistent intensity
  - Neat & concise
- Fully labelled points and profiles

NOTE: It is suggested that this is a paired task to achieve the drawing and fairing requirements. This is an extension to the previous lofting work.

Line (GAC): D CREATE LOFTS

Competency: D4 Proof a refined lines plan

Objectives

To be competent in this area, the individual must be able to:

- Apply quality control to the lines plan.
- Determine construction dimensions for structural components.
- Develop profiles, patterns and templates.
- Use applicable terminology.

LEARNING TASKS	CONTENT
1. Establish diagonals (quality control) in the body plan to confirm fairness	• Plot profiles
2. Confirm finished fairness	• Codes and standards • Critical thinking • Neatness • Accuracy • Application of corrections
3. Determine construction dimensions for structural components	• Keel • Stem • Frame • Bulkhead • Stern frame • Girder
4. Develop various profiles	• Keel • Stem • Frame • Bulkhead • Stern frame • Girder
5. Develop patterns and templates	• Material • Scale • Keel • Stem • Frame • Bulkhead • Stern frame • Girder

Achievement Criteria

Performance	The learner will be able to construct an approximately 12' × 14' (3.6 m × 4.2 m) full-size template or pattern of a structural hull component.
Conditions	The learner will be given: • A proven lines plan • Plywood/cardboard • Suitable pattern stock • Shop space • Tools & materials • 6 hours to complete task
Criteria	The learner will be evaluated on: • Accuracy of the finished patterns • All required dimensions • Check dimensions • Correct labelling and reference information **NOTE:** It is suggested that this is a paired task to achieve the drawing and fairing requirements. This is an extension to the previous lofting work.

Line (GAC): E CONSTRUCT AND REPAIR SHIP STRUCTURES

Competency: E1 Use a jig in ship construction

Objectives

To be competent in this area, the individual must be able to:

- Describe principles and methods of jig design, construction and application in the shipbuilding and repair industry.

LEARNING TASKS	CONTENT
1. Describe the purpose and function of jigs	• Accuracy control • Efficiency
2. Identify types of jigs	• Alignment • External • Internal • Pin • Modular • Incremental • Overlay

3. Describe the design and construction of jigs	• Tolerances
	• Terminology
	  ○ Offset
	  ○ Sheer
	  ○ Camber
	• Alignment
	• Construction process
	• Labelling
	• Materials
	• Types of fasteners

Line (GAC): E CONSTRUCT AND REPAIR SHIP STRUCTURES

Competency: E2 Assemble ship structures

Objectives

To be competent in this area, the individual must be able to:

- Construct ship structures.

LEARNING TASKS	CONTENT
1. Interpret blueprint	• Marine terminology • Hull form • Sequencing • Stages of fabrication

2. Inspect components	• Material
	  ○ Steel
	  ○ Aluminum
	  ○ Stainless
	  ○ Heat numbers
	  ○ Grade
	  ○ Quantity
	  ○ Size
	  ○ Shape

3. Apply initial quality control	• Layout • Points • Origins • Component number • Master datum • Deck number • Direction marks • Mitre • Bevel angles

4. Assemble components	• Parts
	• Sub-assemblies
	• Weldments
	  ○ Weld procedures
	  ○ Weld allowances
	  ○ Weld preps

5. Inspect after assembly	• Measurements • Distortion • Fit up • NDE (non-destructive examination)

LEARNING TASKS	CONTENT
6. Apply reference marks	• Bow thruster • Plimsoll • Water line • Boot top marking • Bulbous bow marking • Frame locations • Warning markings • Keel markings

Achievement Criteria

Performance — The learner will be able to:

- Develop and follow a work plan.
- Build a block module 20' × 15' × 15' (6.1 m × 4.5 m × 4.5 m) comprised of ¼" (6 mm) steel plate material.

Conditions — The learner will be given:

- Drawings
- ¼" (6 mm) steel plate or thicker
- Codes and standards (IACS)
- Shop space
- Shop tools and equipment
- 30 hours to complete the task

Criteria — The learner will be evaluated on:

- Safe use of material handling
- Work safely and in a professional manner
- Alignment
- Fairness
- Orientation
- Fit up
- Equipment useage
- Application of drawings and standards
- Work plan is followed

NOTE: It is suggested that this is a paired task to achieve the drawing and fairing requirements. This is an extension to the previous lofting work.

Line (GAC): E CONSTRUCT AND REPAIR SHIP STRUCTURES

Competency: E3 Outfit ships

Objectives

To be competent in this area, the individual must be able to:

- Accurately level, locate and align components to ship structure.
- Use applicable terminology.

LEARNING TASKS	CONTENT

1. Interpret blueprint	• Location
	• Measurements
	• Coordination with
	  ○ Other trades
	  ○ Other departments
	  ○ Other drawings

2. Select components	• Types of components
	  ○ Deck fittings
	  ○ Electrical
	  ○ Mechanical
	  ○ Piping
	  ○ Safety equipment
	• Furnishings

3. Layout components	• Reference lines
	  ○ Baseline
	  ○ Waterline
	  ○ Centre line
	  ○ Frame line

4. Fit components	• Tools
	  ○ Plumb bob
	  ○ Declivity level
	  ○ Builders' level
	• Securing
	  ○ Come-alongs
	  ○ Turnbuckles
	  ○ Fasteners
	  ○ Clamps
	  ○ Clips
	  ○ Wedges
	• Scribe
	• Trim/green allowance
	• Rigging
	• Shoring and blocking

LEARNING TASKS	CONTENT

5. Weld components	• Weld procedures
	  ○ Weld allowances
	  ○ Weld preps

6. Apply quality control	• Alignment • Level • Plumb • Datum location • Orientation • Codes and standards

Achievement Criteria

Performance — The learner will be able to locate, align and level outfitting components.

Conditions — The learner will be given:

- ¼" (6 mm) steel plate
- Relevant drawings, codes and standards
- Tools and equipment
- Material handling equipment
- 6 hours to install and QC

Criteria — The learner will be evaluated on:

- Safe use of material handling
- Work safely and in a professional manner
- Alignment
- Fairness
- Orientation
- Fit up
- Equipment useage
- Application of drawings and standards
- Work plan is followed
- Weld symbols

NOTE: It is suggested that this is a paired task to achieve the drawing and fairing requirements. This is an extension to the previous lofting work.

Line (GAC): E CONSTRUCT AND REPAIR SHIP STRUCTURES

Competency: E4 Erect hull blocks

Objectives

To be competent in this area, the individual must be able to:

- Describe hull block assembly to complete ship construction.
- Describe quality control considerations.

LEARNING TASKS	CONTENT

1. Describe drawing	• Hull block drawing
	• Code allowances
	• Block erection sequence
	  ○ Block numbers
	  ○ Blocks
	  ○ Grand blocks

2. Describe block transport methods	• Crane
	• Self-Propelled Modular Transporter (SPMT)
	• Lift plan
	  ○ Roles and responsibilities
	  ○ Lift route
	  ○ Lift points
	  ○ Rigging selection
	  ○ Communication
	  ○ Documentation

3. Identify specific references for block size, orientation and placement	• Datums
	  ○ Base line
	  ○ Centre line
	  ○ Frame line
	  ○ Level line
	  ○ Water line
	• Orientation reference
	  ○ Structure
	  ○ Geometry

4. Describe fit up	• Tools
	  ○ Plumb bob
	  ○ Builders' level
	  ○ Transit
	• Securing and shoring
	  ○ Dunnage
	  ○ Blocking
	  ○ Come-alongs
	  ○ Turnbuckles
	  ○ Fairing aids

LEARNING TASKS	CONTENT

6. Describe weld process	• Weld procedures
	  ○ Weld allowances
	  ○ Weld preps
	• Welding sequence
	• Distortion controls

7. Describe quality control	• Alignment
	• Level
	• Plumb
	• Datum location
	• Orientation
	• Codes and standards
	• Documentation
	  ○ NDE
	  ○ Accuracy control reports
	  ○ Weigh blocks & grand blocks

8. Describe access and egress	• Ramps • Scaffolds • Controls • Barriers • Safety

Line (GAC): E CONSTRUCT AND REPAIR SHIP STRUCTURES

Competency: E5 Repair ship structures

Objectives

To be competent in this area, the individual must be able to:

- Describe the process for repairing ship structures.
- Explain quality control.

LEARNING TASKS	CONTENT

1. Describe the process for determining the scope of repair	• Roles and responsibilities
	  ○ Customer
	  – Specifications
	  – Drawings
	  ○ Classification Societies
	  – Codes and standards
	  – Inspection
	  ○ Yard
	  – Work planning and estimation
	  – Tool and equipment selection
	  – Materials
	  – Location hazards
	  ▪ Ventilation
	  ▪ Access
	  ▪ Obstacles
	  ▪ Lock out requirements
	  ▪ Environmental issues
	• Coordination
	• Terminology

2. Describe the dry docking process	• Preparation
	  ○ Dry dock layout
	• Berthing plan
	  ○ Tide and current tables
	  ○ Facility
	  ○ Personnel
	  ○ Safety
	  ○ Communications
	  ○ Documentation
	• Positioning
	  ○ Blocks
	  ○ Shores
	  ○ Leveling
	  ○ Line handling
	  ○ Capstan

LEARNING TASKS	CONTENT

3. Describe repair processes for a double bottom	• Work plan
	  ○ Materials
	  ○ Logistics
	  ○ Prep staff
	  ○ Equipment
	  ○ Coordination
	• Specifications
	• Location hazards
	  ○ Assessments
	  ○ Ventilation
	  ○ Access
	  ○ Obstacles
	  ○ Lock out requirements
	  ○ Environmental issues
	• Damaged structure removal
	• Work points and datums
	• Template
	• Fabrication
	• Inspection
	• Rigging

Section 4

TRAINING PROVIDER STANDARDS

Facility Requirements

Note: Facilities will vary by location. The classroom and shop dimensions and facilities listed below are ideal with the understanding that some flexibility may be required in order to make use of multi-purpose space or facilities shared with other training programs.

Classroom Area

- Classroom (approx. 900 sq. ft. or 86 m^2)
- Instructional media to include instructor's computer station, multimedia projector and screen and/or large screen monitor, flipchart and whiteboard

Shop Area

- **Lofting area** appropriate for scaled down lofting projects: approximate area should be 4' × 8' (1.2 m × 2.4 m) for each work station per person plus sufficient space between stations for ease of movement. If possible an area of 1,600 sq. ft./110 m^2 (approx. 20' × 60' or 6.1 m × 18 m) would allow for some full scale lofting exercises.
- **Welding shop**: 800 sq. ft. (74 m^2) (approx. 20' × 40' or 6.1 m × 12.2 m) with specialized safety systems appropriate to the equipment
- **Indoor workshop**: Approximately 200 sq. ft. (17.6 m^2) per student, ideally with moveable lifting device (minimum 1 Tonne capacity)
- **Outdoor workshop**: 900 sq. ft. (86 m^2) with 20' (6.1 m) overhead clearance. Space must be covered with sufficient power supply for tools and equipment.

Student Facilities

- Change rooms and individual lockers

Instructor's Office Space

- Approximately 150 sq. ft. (16 m^2) per instructor, with a desk, chairs and materials storage/filing system

Other

- Materials storage: Approximately 200 sq. ft. (17.6 m^2) raw materials storage (may be outdoors)
- Tools storage: Approximately 20 sq. ft. (2.5 m^2) per student – lockable (indoors)

Tools and Equipment

Shop Equipment and Tools

Safety Equipment

- Respirators
- Fall arrest

Tools and Materials (required for lofting)

- Three-sided scale
- Various flexible battens
- Bevel set
- Cage templates
- Soapstone
- Chalk line
- Scribe
- Marker
- Dividers

Cutting Tools and Equipment

- Band saw
- Hand saw
- Jig saw
- Circular saw
- Cutting Torch
- Portable plasma cutter
- Cold cut saws
- Burning Table
- Ironworker
- Shear

Securing Equipment

- Come-alongs
- Turnbuckles
- Fasteners
- Plate clamp

Welding Equipment

- Oxy-acetylene
- Arc welding
- FCAW

- GMAW

Alignment Tools

- Builder's level
- Laser transit
- Piano wire
- Straightedge
- Feeler gauges
- Tape measure
- Clinometer
- Plumb bob
- Hydraulic jacks
- Hammers and wedges
- Declevity level
- Turnbuckles
- Strongbacks
- Dogs
- Wedges

Metal Shaping Tools and Equipment

- Rosebud Torch
- Brake press
- Male and female dies
- Rolls
- Weights
- Grinder
- Die grinder
- Radiograph
- Slab or pin jig

Lifting Equipment

- Overhead bridge span crane
- A-frame crane (mobile)
- Rigging equipment
    - Shackles
    - Slings
    - Chokers
    - Spreader beams
    - Plate clamps

Student Equipment (supplied by school)

Required

- Face shield
- Leather aprons
- Dust masks
- Welding helmet
- Hearing protection
- Hand tools

Student Tools (supplied by student)

Required

- Steel-toe workboots (CSA compliant)
- Gloves
- Eye protection

Recommended

- Close-fitting pants, shirts and jackets
- Coveralls

Reference Materials

Recommended Reference Materials

- Ship Knowledge – Covering Ship Design and Construction, 2nd Edition, K. van Dokkum; ISBN# 90-806330-6-2
- Ship Construction 6th Edition, D. J. Eyres; Butterworth-Heinemann, Oxford, UK, 2007

Instructor Requirements

Occupation Qualification

The instructor must possess:

- BC Marine Fitter Endorsement

  OR

- Metal Fabricator Certificate of Qualification or Boilermaker Certificate of Qualification with Red Seal Endorsement
  - Plus a minimum of 5 years of experience performing marine fitting work.

Instructional Experience and Education

It is preferred that the instructor also possesses the following:

- Provincial (B.C.) Instructor Diploma or completion of a similar trainer training or instructional methods program
- Demonstrated ability to supervise the work of others
- Demonstrated effectiveness in communication skills - instructional and interpersonal
- Working knowledge of relevant software programs for:
  - Word processing
  - Spreadsheets
  - Presentations
  - CAD

Appendices

Appendix A: Glossary of Acronyms

ABS:	American Bureau of Shipping
ASME:	American Society of Mechanical Engineers
BL:	Baseline
BV:	Bureau Veritas
CL:	Centre line
D@CL:	Deck at centre line
D@S:	Desk at side
DNV:	Det Norske Veritas
DWL:	Design water line
FLRA:	Field level risk assessment
IACS:	International Association of Classification Societies
ISO:	International Organization for Standardization
LOA:	Length overall
NDE:	Non-destructive examination
OSHA:	Occupational Safety and Health Association
PPE:	Personal protective equipment
PWBS:	Product work breakdown structure
Rad Haz:	Radiation hazard
SNAME:	Society of Naval Architects and Marine Engineers
SOP:	Safe operating procedures
SPMT:	Self-propelled modular transporter
SWP:	Safe working practices
WL:	Water line

Appendix B: Assessment Guidelines

GRADING SHEET: SUBJECT COMPETENCY AND WEIGHTINGS

PROGRAM: IN-SCHOOL TRAINING:	MARINE FITTER ENDORSEMENT		
LINE	**SUBJECT COMPETENCIES**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
A	UNDERSTAND THE SHIPBUILDING AND REPAIR INDUSTRY	15%	0%
B	DEMONSTRATE SAFE WORK PRACTICES	20%	25%
C	READ SHIP DRAWINGS	30%	25%
D	CREATE LOFTS	15%	25%
E	CONSTRUCT AND REPAIR SHIP STRUCTURES	20%	25%
	Total	**100%**	**100%**
In-school theory / practical subject competency weighting		20%	80%
Final in-school percentage score Apprentices must achieve a minimum 70% as the final in-school percentage score to be eligible to write SkilledTradesBC Standardized exam		**IN-SCHOOL %**	

SkilledTradesBC Standardized Written Exam Mark A score of 70% or higher is required for a pass.	**EXAM%**

All apprentices who complete the optional Marine Fitter Endorsement with a FINAL level percentage score of 70% or greater will write the SkilledTradesBC Standardized examination as their final assessment.