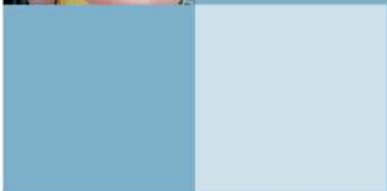
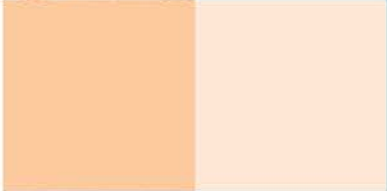
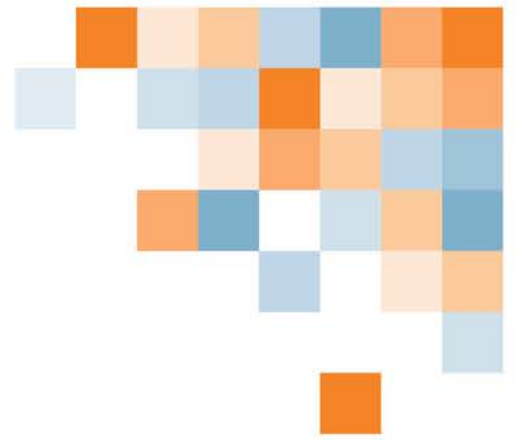


ita
YOUR TICKET.



PROGRAM OUTLINE

Marine Service Technician



The latest version of this document is available in PDF format on the ITA website
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MARINE SERVICE TECHNICIAN PROGRAM OUTLINE

**APPROVED BY INDUSTRY
OCTOBER 2017**

**Developed by
Industry Training Authority
Province of British Columbia**



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Section 1

INTRODUCTION

Marine Service Technician



Foreword

Marine Service Technician refers to a tradesperson who performs any combination of service, repair, construction or installation of recreational vessels and light commercial vessels, with marine specialty skills in one or more of the following areas: composites technology, refinishing, woodworking, metals, systems installation and rigging. They may be employed by boat repair yards, marinas, yacht manufacturing facilities, yacht clubs, marine dealerships or specialty marine service providing businesses.

The Marine Service Technician trade (formerly Marine Repair Technician) was developed by industry stakeholders to meet the needs of boatyard facilities servicing the recreational marine sector in British Columbia. The industry is characterized by a great variety of businesses; some offering full service facilities, capable of servicing the entire vessel while others specialize in only one aspect of the industry.

To capture this range of work, the program outline covers a wide variety of activities and competencies under one trade designation. An MST trade worker is not expected to perform all the competencies covered in this Program Outline, but instead specialize in their area(s) of choice. Apprentices in the trade are however expected to learn about the various boatyard activities so that they understand the whole boat philosophy and the nature of the boatyard workplace. Certain practical exercises, expected of all apprentices, are achieved through institutional training or exposure on the job. High level trade skills are selected from a list of Advanced Competencies and are gained through on the job experiences with assessment facilitated by the training institute standards program.

This Program Outline was developed by a diverse group of industry business owners, facility managers and workers representing a cross section of the industry in British Columbia.

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.



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The Program Outline was prepared with the advice and direction of industry subject matter experts retained as outline reviewers:

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The Industry Training Authority would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Marine Service Technician occupation.



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	Apprentices	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 general areas of competency (GACs) at each program level, the suggested proportion of time spent on each GAC, and percentage of time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	Understand the relative weightings of various competencies of the occupation on which assessment is based
Program Content	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



Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
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

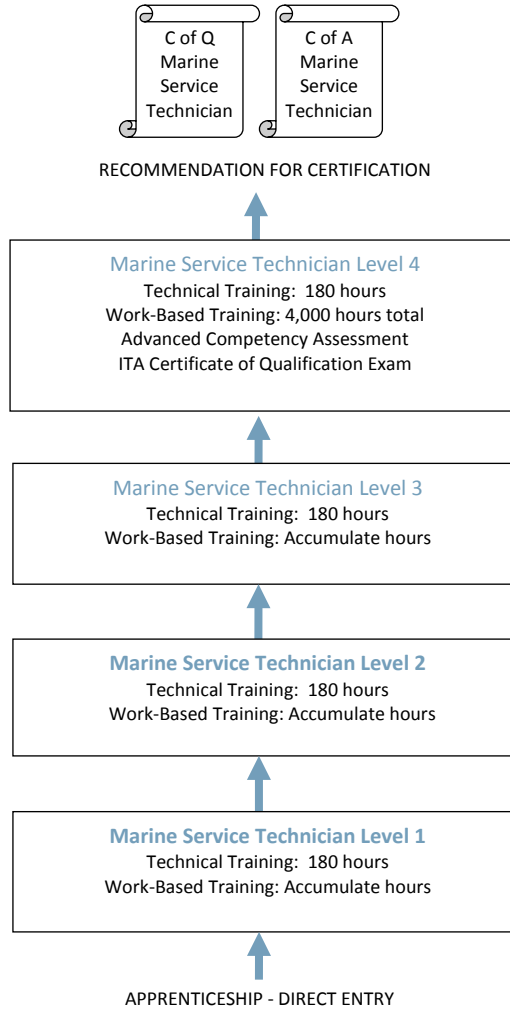
Marine Service Technician



Program Overview

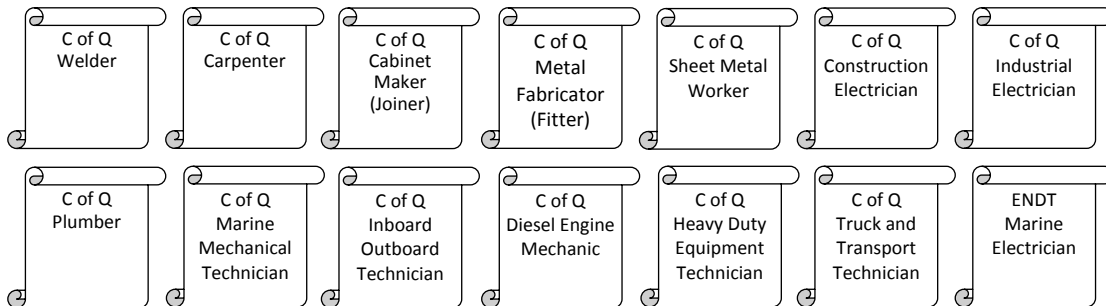
Program Credentialing Model

Certificate of Qualification (C of Q)
Certificate of Apprenticeship (C of A)
Work-Based Training (WBT)



CROSS-PROGRAM CREDITS

Individuals who hold the credentials below are entitled to receive a **500 WBT** hour credit toward the completion requirements of this program





Occupational Analysis Chart

MARINE SERVICE TECHNICIAN

Occupation Description: “Marine Service Technician” refers to a tradesperson who performs any combination of service, repair, construction or installation of recreational vessels and light commercial vessels, with marine specialty skills in one or more of the following areas: composites technology, refinishing, woodworking, metals, systems installation and rigging. They may be employed by boat repair yards, marinas, yacht manufacturing facilities, yacht clubs, marine dealerships or specialty marine service providing businesses.

SAFETY A	Apply Safe Work Practices A1 1	Respond to Workplace Emergencies A2 1				
	YARD MANAGEMENT B	Apply Professional Boatyard Business Practices B1 1 4	Describe Role of Surveyors and Insurance Adjusters B2 4	Manage Projects B3 4 AWC		
YARD PRACTICES C		Apply Environmental Protection Practices C1 1 4	Secure and Block Vessels C2 1	Identify the Consequences of Vessel and Engine Submersion C3 4	Operate Power and Sail Vessels W AWC	Operate Vessel Lifting and Maneuvering Equipment W AWC
	TECHNOLOGY AND DESIGN D	Define Trade Terminology and Concepts D1 1	Create Technical Drawings D2 1 AWC	Describe Design Basics D3 2	Describe Principals of Powering D4 2	Describe Wood Vessel Construction D5 3

W = Competencies for which knowledge or skills are primarily acquired in the workplace.

AWC = Advanced Workplace Competency. See Section 4 for more information regarding Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Describe Metal Vessel Construction					Perform Lofting Operations					Perform Layout and Fitting Operations				
D7					D8					D9				
		3					3		AWC		2			

TRADE MATHEMATICS
E

Apply Trade Math					Perform Measurement Operations				
E1					E2				
1					1				

TOOLS AND EQUIPMENT
F

Use Hand Tools					Use Portable Power Tools					Use Stationary Power Tools					Use Compressed Air Delivery Systems					Use Spray Equipment					Maintain Workplace Electrical Equipment				
F1					F2					F3					F4					F5					F6				
1					1							3				2					2				1				

MATERIALS
G

Select Wood Repair Materials					Select Composite Materials					Use Thermoplastics					Select Marine Metals					Select Fasteners					Use Adhesive and Bedding Compounds				
G1					G2					G3					G4					G5					G6				
1					1	2							4			2					2					2			

Use Abrasive Materials				
G7				
1				

MARINE METALS
H

Drill and Cut Metals					Weld Marine Metals					Fabricate with Marine Metals					Control Corrosion in Metals				
H1					H2					H3					H4				
	2				W				AWC	W				AWC			3		AWC

W = Competencies for which knowledge or skills are primarily acquired in the workplace.
 AWC = Advanced Workplace Competency. See Section 4 for more information regarding Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Program Overview

WOODWORK I	Assess Rot and Deterioration Damage I1 1	Perform Structural Repairs I2 3 AWC	Perform Fairing and Cosmetic Operation I3 4 AWC	Use Traditional Caulking Methods I4 W AWC	Repair Teak Decking I5 W AWC	Perform Cold Molding I6 4 AWC
	Perform Wood Laminating I7 4 AWC	Perform Joinery I8 W AWC	Sheath Wood Structure with Composite Materials I9 4			
COMPOSITE J	Fabricate FRP Tooling J1 3 AWC	Repair FRP Structures J2 1 2 3 AWC	Repair Keel Impact Damage J3 2 AWC	Repair FRP Rudders and Stabilizers J4 3 AWC	Repair Osmosis Damage J5 2 AWC	Perform Vacuum Bag Laminating J6 3 AWC
	Repair High Performance FRP Structures J7 4 AWC	Maintain Gel Coat Surfaces J8 1	Repair Gel Coat Damage J9 1 AWC			
MECHANICAL SYSTEMS K	Identify Engine and Drivetrain Components K1 1	Describe Engine Room Layout and Ventilation K2 2	Remove and Install Engines K3 3 AWC	Perform Engine Pre-Start Inspection K4 3	Service Marine Engine Components K5 3 AWC	Service Engine Controls, Alarms and Gauges K6 3 AWC
	Service Steering Gear K7 3 AWC	Service Engine Mounts, Shafting and Alignment K8 2 AWC	Service Propellers K9 2 AWC	Install and Service Hydraulic Systems K10 3 AWC	Service Engine Starting and Charging Systems K11 3 AWC	

W = Competencies for which knowledge or skills are primarily acquired in the workplace.

AWC = Advanced Workplace Competency. See Section 4 for more information regarding Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Program Overview

ELECTRICAL L	Calculate Current, Resistance and Voltage L1	Perform Basic Wiring and Testing Procedures L2	Install and Service DC Power Supply and Distribution Systems L3	Install and Service AC Power Supply and Distribution Systems L4	Install Alternative Power Sources L5	
	2	2	3 AWC	4 AWC	W AWC	
ELECTRONICS M	Install Basic Electronics and Networks M1	Install Advanced Electronics M2	Install Advanced Electronic Networks M3			
	4	W AWC	W AWC			
INSTALLATIONS N	Install Hardware and Fittings N1	Install Thru-Hulls and Underwater Equipment N2	Install and Service Fresh Water Systems N3	Install and Service Waste Water Systems N4	Describe Propane Distribution Systems N5	Install and Service Heating Systems N6
	3	3 AWC	2 AWC	2 AWC	3	3 AWC
	Install and Service Refrigeration and Air Conditioning Systems N7					
	3 AWC					
RIGGING O	Install and Service Standing Rigging O1	Install and Service Running Rigging O2	Step, Unstep and Store Masts O3	Install and Service Deck Hardware O4	Splice Lines O5	Tune Rigging O6
	2 AWC	2 AWC	W AWC	W AWC	W AWC	W AWC
	Build Spars O7	Service and Repair Carbon Spars O8				
	W AWC	W AWC				

W = Competencies for which knowledge or skills are primarily acquired in the workplace.

AWC = Advanced Workplace Competency. See Section 4 for more information regarding Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



FINISHING AND PAINTING
P

Apply Utility Coatings by Brush and Roller					P1
	2				

Apply Anti-Fouling Paints					P2
1					AWC

Mark and Mask Waterlines and Stripes					P3
			4		AWC

Prep and Prime for Multi-Component Topcoats					P4
			4		AWC

Spray Multi-Component Topcoats					P5
			4		AWC

Repair Multi-Component Topcoats					P6
			4		AWC

Brush-Apply Gloss Paints and Varnishes					P7
	2				AWC

Perform Detailing					P8
W					AWC

Prime and Fair Metals					P9
		3			AWC

TENDERS
Q

Service and Repair Inflatable Vessels					Q1
W					AWC

Install and Service Cranes, Davits and Hoists					Q2
			4		AWC

W = Competencies for which knowledge or skills are primarily acquired in the workplace.
 AWC = Advanced Workplace Competency. See Section 4 for more information regarding Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Training Topics and Suggested Time Allocation Level 1

MARINE SERVICE TECHNICIAN – LEVEL 1

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
Line A	SAFETY	6%	40%	60%	100%
A1	Apply Safe Work Practices		✓	✓	
A2	Respond to Workplace Emergencies		✓	✓	
Line B	YARD MANAGEMENT	6%	50%	50%	100%
B1	Apply Professional Boatyard Business Practices		✓	✓	
Line C	YARD PRACTICES	3%	20%	80%	100%
C1	Apply Environmental Protection Practices		✓		
C2	Secure and Block Vessels		✓	✓	
Line D	TECHNOLOGY AND DESIGN	18%	70%	30%	100%
D1	Define Trade Terminology and Concepts		✓		
D2	Create Technical Drawings		✓	✓	
Line E	TRADE MATHEMATICS	12%	75%	25%	100%
E1	Apply Trade Math		✓		
E2	Perform Measurement Operations		✓	✓	
Line F	TOOLS AND EQUIPMENT	16%	40%	60%	100%
F1	Use Hand Tools		✓		
F2	Use Portable Power Tools		✓	✓	
F6	Maintain Workplace Electrical Equipment		✓	✓	
Line G	MATERIALS	12%	70%	30%	100%
G1	Select Wood Repair Materials		✓		
G2	Select Composite Materials		✓		
G7	Use Abrasive Materials		✓	✓	
Line I	WOODWORK	3%	100%	0%	100%
I1	Assess Rot and Deterioration Damage		✓		
Line J	COMPOSITE	18%	40%	60%	100%
J2	Repair FRP Structures		✓	✓	
J8	Maintain Gel Coat Surfaces		✓	✓	
J9	Repair Gel Coat Damage		✓		



Line K	MECHANICAL SYSTEMS	3%	100%	0%	100%
K1	Identify Engine and Drivetrain Components		✓		
Line P	FINISHING AND PAINTING	3%	100%	0%	100%
P2	Apply Anti-Fouling Paints		✓		
Total Percentage for Marine Service Technician Level 1		100%			



Training Topics and Suggested Time Allocation Level 2

MARINE SERVICE TECHNICIAN – LEVEL 2

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
Line D	TECHNOLOGY AND DESIGN	28%	75%	25%	100%
D3	Describe Design Basics		✓		
D4	Describe Principals of Powering		✓		
D9	Perform Layout and Fitting Operations		✓	✓	
Line F	TOOLS AND EQUIPMENT	6%	50%	50%	100%
F4	Use Compressed Air Delivery Systems		✓		
F5	Use Spray Equipment		✓	✓	
Line G	MATERIALS	10%	75%	25%	100%
G2	Select Composite Materials		✓		
G4	Select Marine Metals		✓		
G5	Select Fasteners		✓		
G6	Use Adhesive and Bedding Compounds		✓	✓	
Line H	MARINE METALS	4%	0%	100%	100%
H1	Drill and Cut Metals			✓	
Line J	COMPOSITE	18%	50%	50%	100%
J2	Repair FRP Structures		✓		
J3	Repair Keel Impact Damage		✓		
J5	Repair Osmosis Damage		✓		
Line K	MECHANICAL SYSTEMS	10%	65%	35%	100%
K2	Describe Engine Room Layout and Ventilation		✓		
K8	Service Engine Mounts, Shafting and Alignment		✓		
K9	Service Propellers		✓	✓	
Line L	ELECTRICAL	6%	65%	35%	100%
L1	Calculate Current, Resistance and Voltage		✓		
L2	Perform Basic Wiring and Testing Procedures		✓	✓	
Line N	INSTALLATIONS	6%	100%	0%	100%
N3	Install and Service Fresh Water Systems		✓		
N4	Install and Service Waste Water Systems		✓		



Line O	RIGGING	6%	100%	0%	100%
O1	Install and Service Standing Rigging		✓		
O2	Install and Service Running Rigging		✓		
Line P	FINISHING AND PAINTING	6%	100%	0%	100%
P1	Apply Utility Coatings by Brush and Roller		✓		
P7	Brush-Apply Gloss Paints and Varnishes		✓		
Total Percentage for Marine Service Technician Level 2		100%			



Training Topics and Suggested Time Allocation Level 3

MARINE SERVICE TECHNICIAN – LEVEL 3

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
Line D	TECHNOLOGY AND DESIGN	10%	100%	0%	100%
D5	Describe Wood Vessel Construction		✓		
D6	Describe FRP Vessel Construction		✓		
D7	Describe Metal Vessel Construction		✓		
D8	Perform Lofting Operations		✓		
Line F	TOOLS AND EQUIPMENT	6%	0%	100%	100%
F3	Use Stationary Power Tools			✓	
Line H	MARINE METALS	3%	100%	0%	100%
H4	Control Corrosion in Metals		✓		
Line I	WOODWORK	6%	50%	50%	100%
I2	Perform Structural Repairs		✓		
Line J	COMPOSITE	20%	50%	50%	100%
J1	Fabricate FRP Tooling		✓	✓	
J2	Repair FRP Structures		✓		
J4	Repair FRP Rudders and Stabilizers		✓		
J6	Perform Vacuum Bag Laminating		✓		
Line K	MECHANICAL SYSTEMS	25%	80%	20%	100%
K3	Remove and Install Engines		✓		
K4	Perform Engine Pre-Start Inspection		✓	✓	
K5	Service Marine Engine Components		✓	✓	
K6	Service Engine Controls, Alarms and Gauges		✓		
K7	Service Steering Gear		✓		
K10	Install and Service Hydraulic Systems		✓		
K11	Service Engine Starting and Charging Systems		✓		
Line L	ELECTRICAL	6%	80%	20%	100%
L3	Install and Service DC Power Supply and Distribution Systems		✓		
Line N	INSTALLATIONS	18%	60%	40%	100%
N1	Install Hardware and Fittings		✓	✓	
N2	Install Thru-Hulls and Underwater Equipment		✓	✓	
N5	Describe Propane Distribution Systems		✓		
N6	Install and Service Heating Systems		✓	✓	
N7	Install and Service Refrigeration and Air Conditioning Systems		✓		



Line P P9	FINISHING AND PAINTING Prime and Fair Metals	6%	<div style="background-color: #e0e0e0; padding: 5px; display: flex; justify-content: space-between;"> 100% ✓ 0% 100% </div>		
Total Percentage for Marine Service Technician Level 3		100%			



Training Topics and Suggested Time Allocation Level 4

MARINE SERVICE TECHNICIAN – LEVEL 4

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
Line B	YARD MANAGEMENT	14%	75%	25%	100%
B1	Apply Professional Boatyard Business Practices		✓		
B2	Describe Role of Surveyors and Insurance Adjusters		✓		
B3	Manage Projects		✓		
Line C	YARD PRACTICES	10%	50%	50%	100%
C1	Apply Environmental Protection Practices		✓	✓	
C3	Identify the Consequences of Vessel and Engine Submersion		✓		
Line G	MATERIALS	10%	0%	100%	100%
G3	Use Thermoplastics			✓	
Line I	WOODWORK	14%	50%	50%	100%
I3	Perform Fairing and Cosmetic Operation		✓		
I6	Perform Cold Molding		✓		
I7	Perform Wood Laminating		✓		
I9	Sheath Wood Structure with Composite Materials		✓	✓	
Line J	COMPOSITE	10%	30%	70%	100%
J7	Repair High Performance FRP Structures		✓		
Line L	ELECTRICAL	14%	100%	0%	100%
L4	Install and Service AC Power Supply and Distribution Systems		✓		
Line M	ELECTRONICS	10%	50%	50%	100%
M1	Install Basic Electronics and Networks		✓	✓	
Line P	FINISHING AND PAINTING	14%	100%	0%	100%
P3	Mark and Mask Waterlines and Stripes		✓		
P4	Prep and Prime for Multi-Component Topcoats		✓		
P5	Spray Multi-Component Topcoats		✓		
P6	Repair Multi-Component Topcoats		✓		
Line Q	TENDERS	4%	100%	0%	100%
Q2	Install and Service Cranes, Davits and Hoists		✓		
Total Percentage for Marine Service Technician Level 4		100%			



Section 3

PROGRAM CONTENT

Marine Service Technician



Level 1

Marine Service Technician



- Fire prevention
 - Escape routes
 - Batteries

- 4. Assess hazards and mitigate risks
 - Hazardous materials
 - Working at heights
 - Working near water
 - Working around equipment
 - Electrical systems
 - Overhead dangers
 - Confined spaces
 - Uneven ground
 - Changes in weather

- 5. Use personal protective equipment (PPE) and clothing
 - Inspect, adjust, maintain and store
 - Hand protection
 - Leg and foot protection
 - Headgear
 - Eye protection
 - Hearing/ear protection
 - Breathing protection
 - Personal apparel
 - Precautions for weather
 - Barrier creams
 - Fall restraint

Achievement Criteria

Performance The learner will complete a respirator fit test.

Conditions The learner will require:

- Respirator (half face or full face).

Criteria The learner will be evaluated on:

- Respirator adjustment.
- Maintenance and storage.



Line (GAC): A SAFETY
Competency: A2 Respond to Workplace Emergencies

Objectives

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

- Apply emergency response procedures to fires or accidents.

LEARNING TASKS

1. Describe first response and second response procedures for fire emergencies
2. Describe fire extinguisher types, servicing and their use
3. Describe procedures in case of serious workplace injury
4. Use fire extinguisher
5. Obtain certification in OFA Level 1

CONTENT

- First response to fire emergency
- Second response to fire emergency
- Extinguisher types & capacities
- Extinguisher servicing
- Extinguisher handling
- Use of water on fires
- Smothering fires
- Injury & bleeding
- Electrical shock
- Hypothermia & drowning
- Supervised firefighting demonstration
- Recognized OFA Level 1 training program

Achievement Criteria 1

Performance The learner will demonstrate the use of a fire extinguisher.

Conditions The learner will be require:

- Charged fire extinguisher and supervised conditions for extinguishing a small fire.

Criteria The learner will be evaluated on:

- Following safe work practices throughout the entire task.
- Participation in fire extinguishing exercise.

Achievement Criteria 2

Performance The learner will complete OFA Level 1.

Conditions The learner will be require:

- Access to an accredited OFA training provider.

Criteria The learner will be evaluated on:

- Proof of successful completion.



LEARNING TASKS

5. Describe the nature and future trends of the marine repair industry

CONTENT

- Search engines
- Computer security and privacy
- Scope and structure of the marine repair industry
- Industry standards
- Role of surveyor and adjusters

Achievement Criteria

- Performance The learner will be evaluated on:
- Appropriate use of written and electronic documents relevant to the workplace.
 - Ability to access information from manuals and parts catalogues.
- Conditions The learner will require:
- Sample workplace documents.
 - Technical manuals.
 - Parts catalogues.
- Criteria The learner will be evaluated on:
- Complete and accurate communication of technical information.
 - Accuracy of information retrieval and attention to detail.



Line (GAC): C YARD PRACTICES
Competency: C1 Apply Environmental Protection Practices

Objectives

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

- Apply environmental housekeeping practices in the workplace.

LEARNING TASKS

1. Apply housekeeping practices for preventing environmental pollution

CONTENT

- Coatings storage, application & disposal
- Waste materials handling and disposal
- Dust and overspray management
- Chemical & petroleum storage
- General yard maintenance



Line (GAC): C YARD PRACTICES
Competency: C2 Secure and Block Vessels

Objectives

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

- Secure vessels at docks.
- Describe the procedures for hauling and blocking vessels in the yard.

LEARNING TASKS

1. Secure vessels at dockside

2. Identify common haul-out equipment and compare their features (fit for purpose)

3. Describe blocking placement for various vessel types and repair situations

CONTENT

- Types of lines
- Uses of lines
- Common knots & hitches
- Securing vessels
- Shore power

- Travel lifts
- Marine ways
- Vertical lifts
- Trailers & ramps

- Displacement power vessels
- Planning hulls
- Sailing vessels
- Beam blocking sailing vessels
- Risk of damage or distortion to older wood vessels

Achievement Criteria

Performance The learner will:

- Tie common knots.
- Demonstrate line handling.
- Secure vessels at dockside.

Conditions The learner will require:

- Access to various vessels at dockside and on shore (in a boatyard).

Criteria The learner will be evaluated on:

- Fender and line arrangement at dockside.
- Vessel blocking plan.



Line (GAC): **D** **TECHNOLOGY AND DESIGN**
Competency: **D1** **Define Trade Terminology and Concepts**

Objectives

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

- Identify the common terms and concepts used in the trade to describe vessels, their parts, design and performance.

LEARNING TASKS

1. Define the terms used in hull definition

2. Describe the concept and the terms used in describing vessel tonnage

3. Define the terms used in describing vessel performance

4. Define the terms used in the description and design of power vessels

5. Define the terms used in the description and design of sailing vessels

6. Describe concepts of aerodynamics and sailing rig design

CONTENT

- Hull definition
- Hull shapes & characteristics
- Lines plan terminology

- Tonnage measure
- Gross & net tonnage

- Boat speed
- Speed/length ratio
- Hull speed
- Boat motion
- Roll, pitch & yaw

- Powerboat types
- Displacement hulls
- Planing hulls
- Propellers, nozzles & thrusters
- Rudders
- Anti-roll devices

- Rigging terms
- Rig types
- Sail terminology

- Sailboat balance
- Keel types
- Rudder types



Line (GAC): **D** **TECHNOLOGY AND DESIGN**
Competency: **D2** **Create Technical Drawings**

Objectives

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

- Read and interpret technical drawings and lines plans.

LEARNING TASKS

1. Interpret technical drawings

2. Describe the concepts and terminology associated with lines plans.

3. Create simple 3-dimensional drawings

CONTENT

- Use of scale drawings
- Scale rules, imperial & metric
- Views
- 3-dimensional presentations
- Exploded diagrams

- Lines plan terminology
- Concept of fairness
- Uses of the lines plan

- Drawing tools
- Drawing views of 3-dimensional objects
- Labelling and dimensioning

Achievement Criteria

- Performance** The learner will:
- Create a simple 3-dimensional drawing.
- Conditions** The learner will require:
- Drawing materials.
 - Sample specifications.
- Criteria** The learner will be evaluated on:
- Complete and accurate communication of technical information.
 - Accuracy of information retrieval and attention to detail.

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria



Line (GAC): **E** **TRADE MATHEMATICS**
Competency: **E1** **Apply Trade Math**

Objectives

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

- Perform mathematical calculations used in the trade.
- Perform basic calculations involving density, specific gravity, area, and volume.

LEARNING TASKS

1. Perform basic mathematical operations manually and with an electronic calculator

2. Perform basic calculations

3. Calculate areas

4. Calculate volumes

CONTENT

- Basic operations (addition, subtraction, multiplication & division)
- Units and conversions
- Fractions
- Equations
- Powers
- Percentages
- Ratios
- Proportions

- Definition of terms
- Calculations of specific gravity
- Calculations involving density
- Calculate areas of simple shapes
- Calculate areas of complex shapes

- Calculate volume of solids of:
 - Rectangular section
 - Cylindrical section
 - Triangular section



Line (GAC): F TOOLS AND EQUIPMENT

Competency: F1 Use Hand Tools

Objectives

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

- Perform basic operations with and maintain common hand tools.

LEARNING TASKS

1. Identify common hand tools

2. Select and use common hand tools

3. Perform basic tool care

CONTENT

- Common hand tools
- Woodworking tools
- Tools for composite materials
- Mechanics' tools
- Electricians' tools

- Common hand tools
- Woodworking tools
- Tools for composite materials
- Mechanics' tools
- Electricians' tools

- Care of hand tools
- Cleaning, sharpening & repair
- Proper storage
- Grinding and honing edge tools



Line (GAC): F TOOLS AND EQUIPMENT

Competency: F2 Use Portable Power Tools

Objectives

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

- Use and maintain common portable power tools for simple operations.

LEARNING TASKS

1. Identify common portable power tools

2. Select and use common portable power tools

3. Demonstrate basic tool care

CONTENT

- Power tools for woodworking
- Power tools for composite materials
- Power tools for metals
- Electric power tools
- Air power tools

- Power tools for woodworking
- Power tools for composite materials
- Power tools for metals
- Electric power tools
- Air power tools

- Maintenance and cleaning of portable power tools
- Selection of blades & cutters
- Change bits, cutters, blades
- Electrical safety and maintenance
- Compressed air delivery requirements

Achievement Criteria

- Performance** The learner will:
- Inspect and set up common portable power tools.
 - Perform simple tool operations.
 - Maintain common portable power tools.
- Conditions** The learner will require:
- A selection of portable power tools.
- Criteria** The learner will be evaluated on:
- Correct tool set-up, use and maintenance.
 - Participation in a supervised fabrication exercise.



Line (GAC): **F TOOLS AND EQUIPMENT**
Competency: **F6 Maintain Workplace Electrical Equipment**

Objectives

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

- Describe the function of common AC electrical distribution components and equipment found in the boatyard.
- Repair tool power supply cords.

LEARNING TASKS

1. Identify components of various electrical distribution systems commonly found in a boatyard

2. Describe fire and shock hazards related to electrical equipment

3. Maintain extension and equipment supply cords

CONTENT

- Voltages & phases
- Panels, breakers & fuses
- Plugs, receptacles & adapters
- Ground fault interrupters

- Adequate insulation
- Short circuits & ground faults
- Water hazards

- Voltage drop in extension cords
- Implications of voltage drop
- Types & sizes of wire
- Grounding
- Extension cord maintenance
- Equipment power supply cord maintenance
- Installation of extension and power supply cord terminals

Achievement Criteria

Performance The learner will assemble and repair extension cords.

- Conditions** The learner will require:
- Stock extension cord cable, plugs and receptacles.
 - Tools for installing terminals.
 - Testing equipment.

- Criteria** The learner will be evaluated on:
- Clean and secure terminations.
 - Testing power source for voltage.
 - Testing power cord for polarity and continuity.
 - Troubleshooting procedures.
 - Participation in the supervised electrical maintenance exercise.



Line (GAC): **G MATERIALS**
Competency: **G1 Select Wood Repair Materials**

Objectives

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

- Describe the basic properties of commonly used woods used for marine applications
- Select the appropriate wood materials for structural repair situations

LEARNING TASKS

CONTENT

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Describe the basic properties of commonly used wood species
 2. Identify commonly used woods by sight, grain, hardness and smell
 3. Describe the properties and grading system of plywood
 4. Describe the methods of grading, quantity estimating and pricing of woods
 5. Select suitable wood species for the repairs of structural components | <ul style="list-style-type: none"> • How wood grows • Hardwoods & softwoods • Moisture content • Seasoning • Shrinkage • Defects • Rot resistance • Gluing characteristics • Availability
 • Hands on identification • Densities • Strengths • Durability
 • Structural properties of plywood • Wood species used in plywood • Grading • Composite wood
 • Board measure • Moisture meters • Cutting & grading • Plywood size & grades • Estimating quantities required • Pricing
 • Physical properties • Durability • Availability • Grain orientation • Moisture content |
|---|---|



Line (GAC): **G MATERIALS**
Competency: **G2 Select Composite Materials**

Objectives

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

- Identify resins for common marine applications.
- Describe reinforcement fibre types and fabric styles.

LEARNING TASKS

1. Identify marine resin types

2. Describe the use of resin additives

3. Describe the properties of gel coats and their proper uses

4. Describe the factors which influence optimal cure of resins

5. Describe the function of fibres and fabric styles in composite structures

6. Use appropriate resins and reinforcements

CONTENT

- Polyesters, vinylesters, epoxies
- Physical properties
- Advantages & disadvantages
- Catalysts, promoters, accelerators
- Air drying additives
- Fire retardants
- Other additives
- Fillers

- Uses for gel coat
- Gel coat characteristics
- Gel coat additives & pigments
- Repairs

- Temperature
- Moisture
- Mixing ratios
- Contaminants, sunlight, wind
- Shelf life

- Glass, Kevlar®, carbon
- Fibre, weaves & styles
- Characteristics of reinforcement/resin composites
- Handling & storage of reinforcements
- Construction vs. repair requirements
- Handling & storage
- Technical literature



Line (GAC): I **WOODWORK**
Competency: I1 **Assess Rot and Deterioration Damage**

Objectives

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

- Describe the deterioration of marine woodwork due to rot, marine organisms and other environmental elements.

LEARNING TASKS

1. Describe rot damage in wood

2. Describe damage caused by marine organisms

3. Describe other forms of deterioration in wood

CONTENT

- Identification
- Types of rot
- Conditions leading to rot
- Rot prevention
- Rot removal and extent of repairs
- Identification
- Marine borers
- Vulnerable areas & typical damage
- Prevention
- Damage repair
- Identification
- Wood hydrolysis
- Drying & checking
- Abrasion
- Weathering
- Ice



Line (GAC): J **COMPOSITE**
Competency: J2 **Repair FRP Structures**

Objectives

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

- To assess, prepare, re-laminate and resurface structural damage to an un-cored (single skin) laminate.

LEARNING TASKS

1. Describe methods for assessing damage to single skin laminates
2. Describe how laminate design will influence repair procedures
3. Describe how surface preparation, materials choice and curing conditions influence the quality of a repair
4. Protect a boat's interior and exterior from damage or dust contamination while work is in progress
5. Describe how to create an environment that will provide optimal curing conditions for resins
6. Laminate, repair and re-surface a single-skin FRP structure

CONTENT

- Visual inspection
- Sounding
- Grinding to expose laminates
- Material types
- Thickness/stiffness
- Strength considerations
- Shape & finish
- Eliminating damaged material
- Grinding tapers
- Resin/reinforcement options
- Layup schedule & sequence
- Curing conditions
- Masking techniques
- Ventilation/vacuuuming
- Clean up procedures
- Temperature
- Humidity
- Wind, sunlight, contamination
- Tapering (scarf creation) repair area
- Selection and preparation of repair lamination schedules
- Measuring and mixing resins and additives
- Laminating the repair
- Applying filler
- Fairing procedures for flat and curved surfaces
- Finish sanding procedures

**Achievement Criteria**

- Performance** The learner will complete a structural repair on a damaged single skin laminate.
- Conditions** The learner will require:
- A sample panel of damaged single skin damage for assessment and repair.
 - Resin, reinforcement materials and tools required to effect a repair.
- Criteria** The learner will be evaluated on:
- Damage assessment and surface preparation.
 - Participation in stages of lamination and preparation for finishing.

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **J** **COMPOSITE**
Competency: **J8** **Maintain Gel Coat Surfaces**

Objectives

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

- Describe gel coat gloss deterioration.
- Clean, remove stains and polish gel coat surfaces.

LEARNING TASKS

1. Describe the common cosmetic problems of gel coated surfaces

2. Clean gel coat surfaces

3. Polish gel coat surfaces

CONTENT

- Manufacturing defects
- Environmental exposure
- Impact & stress

- Cleaner selection
- Routine cleaning
- Stain removal

- Abrasive polishes
- Polishing equipment & techniques
- Waxes & synthetic finishes

Achievement Criteria

Performance The learner will demonstrate cleaning and polishing techniques for gel coat surfaces.

Conditions The learner will require:

- A selection of commonly used cleaners and polishes for gel coat and cleaning/polishing equipment.
- Sample gel coat surfaces.

Criteria The learner will be evaluated on:

- Appropriate selection of cleaning product(s) and equipment.
- Polishing technique and results.
- Participation in the restoration exercise.



Line (GAC): **J COMPOSITE REPAIRS**
Competency: **J9 Repair Gel Coat Damage**

Objectives

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

- Describe the repair procedures for gel coat damage on smooth and non-skid surfaces.

LEARNING TASKS

1. Assess deteriorated gel coat surfaces and recommend appropriate repairs

2. Describe procedures for repairs to gel coat damage

3. Describe the repair procedures for damaged gel coat surfaces

4. Describe repair procedures for damaged non-skid surfaces

CONTENT

- Surface evaluation
- Limits to re-gel coating
- Refinishing alternatives
- Damage assessment
- Voids
- Gouges & fastener holes
- Colour matching
- Fillers & additives
- Application techniques
- Sanding and finishing
- Preparation of repair area
- Selecting and mixing resin and additives
- Application techniques
- Sanding and finishing
- Types of non-skid surfaces
- Preparation of repair area
- Selecting and mixing resin and additives
- Application techniques

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **K MECHANICAL SYSTEMS**
Competency: **K1 Identify Engine and Drivetrain Components**

Objectives

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

- Describe the function of the external components of inboard and outboard engines.
- Describe the functions of typical marine drive train types.
- Describe their components.

LEARNING TASKS

CONTENT

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Describe the function of marine engine cooling systems and their components
 2. Describe the function of marine exhaust systems and their components
 3. Describe the functions and components of fuel systems
 4. Describe the use and function of engine gauges, warning alarms and instruments
 5. Describe the components of gasoline engine fuel, ventilation and ignition systems
 6. Describe gasoline engine control systems
 7. Describe the components and function of diesel combustion air and fuel systems
 8. Describe diesel engine control systems
 9. Describe drive train types and configurations | <ul style="list-style-type: none"> • Raw water cooling • Fresh water and heat exchangers • Keel cooling • Full flow valves
 • Exhaust system layout • Dry exhaust • Wet exhaust • Sizing • Mufflers • Mixing elbows • Risers & anti-siphon devices
 • Fuel tanks • Line sizing and plumbing • Fillers & vents • Pumps & filters
 • Tachometers, voltmeters, ammeters • Pressure & temperature gauges & alarms
 • Gasoline combustion air systems • Carburation • Electronic fuel injection • Gasoline ignition systems
 • Throttle, choke & gearshift controls
 • Diesel combustion air systems • Diesel fuel systems • Turbochargers
 • Throttle, pre-heating, shut-off, decompression and gearshift controls
 • Inboard • Outboard • Direct drive • V-drive |
|---|---|



10. Identify components of inboard drive train types

- Saildrives
- Inboard/Outboard
- Jet drives
- Pod drives
- Transmissions
- Shafting
- Bearings & couplings
- Stuffing boxes and shaft seals
- Struts
- CV joints
- Propeller configurations



Line (GAC): P **FINISHING AND PAINTING**
Competency: P2 **Apply Anti-Fouling Paints**

Objectives

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

- Determine compatibility of anti-foul paints.
- Select anti-foul paint type.
- Remove previous coatings, prepare hull.
- Apply new coatings.

LEARNING TASKS

1. Select appropriate anti-fouling paint

2. Prepare and apply anti-fouling to new and previously painted hulls

3. Utilize appropriate paint stripping methods for removing anti-fouling

4. Prepare metal surfaces (lead or iron keels) and the apply barrier coatings

5. Prepare aluminum hulls for anti-fouling coatings

CONTENT

- Marine fouling growth
- Types of paint
- Paint compatibility
- Reading compatibility charts
- Preparing new hulls
- Preparing previously painted hulls
- Barrier coatings and primers
- Paint thickness
- Application techniques
- Environmental concerns
- Surface evaluation
- Removing anti-fouling coatings by scraping
- Using chemical paint strippers
- Sanding
- Media blasting techniques
- Cleaning, drying and preparing iron or lead keels for coating
- Media blasting
- Application of barrier coatings to iron & lead keels
- Corrosion problems
- Surface preparation
- Barrier coating applications
- Application sequence for anti-fouling

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute’s Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Level 2

Marine Service Technician



Line (GAC): D TECHNOLOGY AND DESIGN

Competency: D3 Describe Design Basics

Objectives

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

- Describe the basic concepts of hydrostatics, stability, and hull form.
- Compare elements of hull design and testing methods.

LEARNING TASKS

1. Define the terminology used in describing basic hydrostatic principles
2. Describe the Archimedes Principle
3. Describe the righting moment and the stability curve
4. Describe coefficients of form

CONTENT

- Hydrostatics terminology
- Laws that govern floating bodies
- Applications in the workplace
- Origin of the righting moment
- The stability curve
- Shape of the stability curve
- Stability in sailboats
- Stability in power boats
- Measuring stability
- Coast Guard regulations
- Simple roll test
- Block coefficient
- Prismatic coefficient
- Ratios of comparison



Line (GAC): D TECHNOLOGY AND DESIGN

Competency: D4 Describe Principles of Powering

Objectives

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

- Describe the principles governing performance of power driven vessels.
- Describe the procedure for selecting engines, gear ratios and propellers.

LEARNING TASKS

CONTENT

<ol style="list-style-type: none"> 1. Describe the nature of resistance and the forces that limit speed 2. Describe the different hull types required for different speeds 3. Interpret engine performance curves and compare engine rating 4. Describe the basic propeller types, characteristics and dimensions 5. Compare propeller dimensions to engine power and speed 6. Describe shaft selection and bearing spacing 	<ul style="list-style-type: none"> • Components of resistance • Displacement hulls • Planing hulls • Concept of hull speed • Performance curves • Duty cycles • Power prediction methods • Propeller terminology • Propeller types • Propeller selection • Vibration problems • Propeller selection • Propeller shaft sizing • Propeller shaft bearings & spacing
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Line (GAC): F TOOLS AND EQUIPMENT
Competency: F4 Use Compressed Air Delivery Systems

Objectives

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

- Describe the basics of air compressors.
- Use compressed air delivery systems.

LEARNING TASKS

1. Describe the common types of air compressors and their routine maintenance

2. Use compressed air delivery systems

CONTENT

- Air as power source
- Single & two-stage piston compressors
- Rotary vane, diaphragm & screw type compressors
- Maintenance procedures
- Pressure/volume relationship
- Heat/moisture relationship
- Safety around compressed air
- Terminology & materials
- Maintenance
- Dryers, filters, regulators & fittings
- Pipe sizing, pressure drop & air lines
- Recommended layout of shop air delivery system



Line (GAC): F TOOLS AND EQUIPMENT

Competency: F5 Use Spray Equipment

Objectives

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

- Describe the operating principles of spray equipment.
- Use spray equipment for simple coating applications.

LEARNING TASKS

1. Identify types of spray equipment

2. Describe spray equipment components and operating principles

3. Use spray equipment to apply single component coatings

CONTENT

- Airless/Air-assist airless
- Gravity feed
- Siphon feed
- Pressure feed
- Standard and HVLP systems
- Spray equipment components
- Air cap selection
- Fluid tip selection
- Material containers
- Hoses and connectors
- Spray equipment set up and balancing
- Spray gun handling techniques
- Troubleshooting
- Spray equipment clean up procedures

Achievement Criteria

Performance The learner will set up, operate and maintain siphon and gravity feed spray equipment and apply a single component coating.

Conditions The learner will require:

- Siphon/gravity feed spray equipment.
- Materials to demonstrate set up and use of spray equipment.
- Proper ventilation.

Criteria The learner will be evaluated on:

- Equipment set up and site preparation.
- Spray Technique.
- Equipment maintenance.
- Participation in the coating exercise.



Line (GAC): **G** **MATERIALS**
Competency: **G4** **Select Marine Metals**

Objectives

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

- Describe the properties and applications of common marine metals.
- Describe corrosion control methods.
- Select marine metals.

LEARNING TASKS

1. Describe the properties and applications of marine metals

2. Describe the compatibility of marine metals

3. Describe corrosion control methods

4. Select marine metal for application at hand

CONTENT

- Steel
- Stainless steel
- Aluminum
- Bronze
- Conductive non-metals
- Typical applications
- Galvanic series
- Compatibility with non-metallic materials
- Corrosion assessment
- Plating types
- Coatings
- Sacrificial anodes
- Types of metals
- Requirement for application
- Environmental conditions



Line (GAC): **G MATERIALS**
Competency: **G6 Use Adhesives and Bedding Compounds**

Objectives

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

- Describe the characteristics of marine adhesives and bedding compounds.
- Select appropriate materials and demonstrate their use.

LEARNING TASKS

1. Identify and describe commonly used marine adhesive materials and bedding compounds

2. Select appropriate materials and follow bonding procedures for adhesives and bedding compounds

CONTENT

- Wood glues
- Composites adhesives
- Bonding metals, glass and thermoplastics
- Sealants & bedding compounds
- Specialty products

- Material compatibility
- Joint design
- Surface preparation and priming
- Application techniques
- Clean up

Achievement Criteria

- Performance** The learner will select appropriate adhesives or bedding compounds for common marine workplace situations and demonstrate their application.
- Conditions** The learner will require:
- A selection of adhesives and bedding compounds.
 - Adequate materials for demonstrating their use.
- Criteria** The learner will be evaluated on:
- Appropriate material selection.
 - Preparation and application technique.
 - Participation in the bedding exercise.



Line (GAC): H **MARINE METALS**
Competency: H1 **Drill and Cut Metals**

Objectives

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

- Perform basic drilling and cutting operations in marine metals.

LEARNING TASKS

1. Drill and tap holes in metals

2. Cut and shape metals

3. Cut threads in metal rod

CONTENT

- Drills and bits for metals
- Sharpening bits
- Lubricants and heat control
- Drilling techniques for various metals
- Tapping procedures

- Saws
- Files
- Grinders
- Polishing procedures

- Dies
- Cutting threads

Achievement Criteria

- Performance** The learner will perform a simple fabrication exercise that includes basic drilling, cutting, tapping and threading operations with common marine metals.
- Conditions** The learner will require:
- A selection of metalworking tools.
 - Materials adequate for demonstrating drilling, cutting, tapping and threading operations.
- Criteria** The learner will be evaluated on:
- Appropriate material and tool selection.
 - Technique.
 - Accuracy.
 - Participation in the fabrication exercise .



Line (GAC): J **COMPOSITE**
Competency: J2 **Repair FRP Structures**

Objectives

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

- Assess, prepare, re-laminate and resurface structural damage to cored FRP laminates.
- Identify procedures for repairing cored deck structures.

LEARNING TASKS

1. Describe assessment and repair of delaminated core areas by injecting resin

2. Repair cored structures with simple damage to the outer skin and core only

3. Repair cored hull structures with damage to both skins and core

4. Describe the problems associated with teak decking over a cored composite structure

5. Identify the procedures to repair and rebuild damaged cored deck structure

CONTENT

- Causes of delamination
- Sounding the extent of delamination
- Assessing dry delamination
- Drilling and injecting resin into voids

- Damage assessment
- Skin removal
- Core repair/replacement
- Isolating fittings
- Re-lamination

- Problems of access
- Repairing inside skins

- Teak decks and associated core problems
- Removing teak decking
- Cutting open water damaged decks and excavating core materials
- Preparing and installing new core
- Re-lamination

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): J **COMPOSITE**
Competency: J3 **Repair Keel Impact Damage**

Objectives

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

- Assess the repair of major structural damage associated with keel impacts.

LEARNING TASKS

1. Assess structural damage as a result of keel impact
2. Describe the appropriate procedures required to repair/rebuild damaged structures
3. Describe procedures to remove and re-install lead or iron keels

CONTENT

- Effect of keel design to structural damage
- Types of keel damage
- Keel/hull joints
- Stiffening grid
- Engine beds and shafts
- Secondary bonding
- Attached furnishings
- Bulkheads
- Rigging
- Decision to remove keel
- Mast removal
- Dust control measures
- Keel stub repair
- Internal grid & secondaries
- Plumbing/electrical concerns
- Types of fin keels
- Removal & replacement
- Bedding materials
- Inspection of bolts
- The keel/hull seam
- Repainting

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): J **COMPOSITE**
Competency: J5 **Repair Osmosis Damage**

Objectives

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

- Evaluate osmosis damage.
- Identify appropriate repair procedures.

LEARNING TASKS

1. Describe osmosis blistering in FRP laminates

2. Evaluate laminates for osmosis damage and repair

3. Identify procedures for repairs of osmosis damaged hulls

CONTENT

- Osmosis process
- Blister location
- Non-osmosis blisters
- Hydrolyzed laminates

- Testing procedures
- Evaluation of damage
- Repair options

- Shop conditions
- Gel coat and laminate removal
- Drying
- Re-lamination
- Fairing
- Sealing

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **K MECHANICAL SYSTEMS**
Competency: **K8 Service Engine Mounts, Shafting and Alignment**

Objectives

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

- Identify stuffing boxes, shaft seals and bearings.
- Identify the alignment procedure of inboard engines to drive train.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Describe engine alignment procedures

 2. Describe basic maintenance procedures to propeller shafts, seals and supports

 3. Describe alignment of propeller shafts | <ul style="list-style-type: none"> • Feeler gauges • Pry bars • Shims • Tolerances
 • Repacking glands • Servicing dripless seals • Coupling removal • Keys & keyways • Replacing Cutlass bearings • Strut alignment • Shaft zincs
 • Shaft log • Shaft struts • Wire alignment method • Laser alignment method |
|--|--|

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **K** **MECHANICAL SYSTEMS**
Competency: **K9** **Service Propellers**

Objectives

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

- Assess propeller damage.

LEARNING TASKS

CONTENT

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Assess and describe the significance of propeller damage or wear
 2. Remove and replace propellers
 3. Service propellers | <ul style="list-style-type: none"> • Mechanical damage • Cavitation damage • Corrosion damage • Balance
 • Pullers • Heating • Safety • Nuts, keys & keyways • Tapers and fitting
 • Types of propellers • Prop anodes • Prop grease • Prop coatings • Cleaning |
|--|---|

Achievement Criteria

- Performance** The learner will assess propeller damage and perform procedures for removing and replacing propellers.
- Conditions** The learner will require:
- Propellers, shafts and keys.
 - Tools for propeller removal/replacement.
- Criteria** The learner will be evaluated on:
- Appropriate preparation.
 - Tool selection and technique.
 - Accuracy.
 - Participation in the shaft removal and replacement exercise.

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): L **ELECTRICAL**
Competency: L1 **Calculate Current, Resistance and Voltage**

Objectives

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

- Describe the relationships between voltage, current and resistance.
- Perform basic power calculations and tests.
- Select the appropriate wire size.

LEARNING TASKS

1. Describe various voltages found in marine use
2. Perform basic electrical calculations
3. Use multi-meter to confirm Ohm's Law relationships
4. Select appropriate wire size

CONTENT

- 12V, 24V, 32V DC
- 110V, 220V AC
- Ohm's Law
- Practical electrical calculations
- Voltage, resistance & current tests
- Voltage drop
- Load



Line (GAC): **L ELECTRICAL**
Competency: **L2 Perform Basic Wiring and Testing Procedures**

Objectives

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

- Interpret basic wiring diagrams.
- Install simple electrical devices.
- Use a multi-meter to perform basic tests.

LEARNING TASKS

1. Identify common symbols used in wiring diagrams and interpret wiring diagrams

2. Perform basic wiring procedures to install simple electrical devices

3. Use multi-meter to perform basic electrical tests

CONTENT

- Wiring diagram symbols
- Wiring diagrams
- Polarity

- Parallel & series circuits
- Wire connectors & terminals
- Heat shrink
- Routing and securing cabling

- Voltage
- Amperage
- Resistance
- Continuity

Achievement Criteria

- Performance** The learner will:
- Interpret basic 12V DC wiring diagrams.
 - Install common electrical components found on pleasure vessels.
 - Use a multi-meter to perform basic tests.
- Conditions** The learner will require:
- ABYC standards for reference.
 - Electrical wire, devices.
 - Tools necessary to demonstrate basic wiring techniques.
 - Electrical test equipment.
- Criteria** The learner will be evaluated on:
- Appropriate material selection.
 - Layout and installation technique.
 - Compliance with ABYC standards.
 - Participation in the wiring and testing exercise .



Line (GAC): N INSTALLATIONS
Competency: N3 Install and Service Fresh Water Systems

Objectives

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

- Identify the key components of fresh water systems.
- Describe basic service procedures for fresh water systems.
- Describe the removal and installation of fresh water systems.

LEARNING TASKS

CONTENT

1. Identify components of fresh water systems	<ul style="list-style-type: none"> • Tank materials • Tank location & securing • Gravity systems • Pressure systems • Hot water systems • Pumps/filters/valves • Accumulator tanks • Piping selection • Drains
2. Describe basic service procedures for fresh water systems	<ul style="list-style-type: none"> • Strainers • Filters • Winterizing • Pressure testing • Sacrificial anodes • Pumps and accumulator tanks
3. Describe the procedures for removal and installation of fresh water systems	<ul style="list-style-type: none"> • Water tanks • Plumbing Systems • Pressure testing

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **N** **INSTALLATIONS**
Competency: **N4** **Install and Service Waste Water Systems**

Objectives

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

- Identify the key components of waste water systems.
- Describe basic service procedures for waste water systems.
- Describe the removal and installation of waste water systems

LEARNING TASKS

CONTENT

- | | |
|---|---|
| <p>1. Identify types of waste water systems</p> | <ul style="list-style-type: none"> • Black water • Grey water • Bilge water |
| <p>2. Identify components of waste water systems</p> | <ul style="list-style-type: none"> • Tank materials • Tank location & securing • Marine toilets • Pumps <ul style="list-style-type: none"> ○ Sewage ○ Bilge • Discharge locations • Hoses, valves, deck fittings, vents, anti-siphon loops |
| <p>3. Describe basic service procedures for waste water systems</p> | <ul style="list-style-type: none"> • Tanks • Pumps <ul style="list-style-type: none"> ○ Sewage ○ Bilge • Marine toilets • Hoses, valves, deck fittings, vents, anti-siphon loops |
| <p>4. Describe the procedures for removal and installation of waste water systems</p> | <ul style="list-style-type: none"> • Tanks • Pumps <ul style="list-style-type: none"> ○ Sewage ○ Bilge • Safety considerations • Regulatory standards • Hoses, valves, deck fittings, vents, anti-siphon loops |

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria



Line (GAC): **O** **RIGGING**
Competency: **O1** **Install and Service Standing Rigging**

Objectives

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

- Identify components of spars and standing rigging.
- Describe visual inspection techniques.

LEARNING TASKS

1. Identify spar components

2. Identify standing rigging components

3. Describe visual inspection of standing rigging

4. Describe installation and service procedures for roller furling systems

CONTENT

- Mast
- Spreaders
- Boom
- Hardware
- Step and deck fittings
- Other spars
 - Bow sprit
 - Boomkin
 - Sail control
- Types of standing rigging systems, selection to meet working loads
- Rigging terminals
- Common swaging techniques
- Corrosion and fatigue
- Typical wear and damage
- Dye testing
- Forestay roller furling systems
- Mainsail furling systems
- Other furling systems
 - Asymmetrical
 - Symmetrical

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **O** **RIGGING**
Competency: **O2** **Install and Service Running Rigging**

Objectives

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

- Identify components of running rigging.
- Describe installation and service procedures.

LEARNING TASKS

1. Identify running rigging components

2. Describe installation and service procedures for blocks and sheaves

3. Describe installation and service procedures for halyards and other running rigging

CONTENT

- Sheaves and blocks
- Line construction and selection
- Line control equipment
- Shackles and terminals

- Associated tackle types and selection
- Working loads and selection criteria
- Visual inspection for damage

- Selection of lines and wire
- Line length calculation
- Line layout
- Visual inspection for damage

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute’s Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): P **FINISHING AND PAINTING**
Competency: P1 **Apply Utility Coatings by Brush and Roller**

Objectives

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

- Describe the range and application of utility coatings.
- Select and apply utility coatings using brush and roller.

LEARNING TASKS

1. Describe the characteristics and appropriate uses of utility coatings

2. Describe the commonly used wood preservatives

3. Describe the uses and application of coatings on metals

4. Select and apply utility coatings by brush and roller

CONTENT

- Primers
- Enamels
- Clear finishes
- Above & below waterline coatings
- FRP and wood substrate considerations

- Safety considerations
- Copper & zinc naphthenate
- Creosote
- Kerosene & linseed oil
- Appropriate applications

- Steel
- Aluminum
- Special considerations for coating metals

- Ambient conditions
- Mixing & thinning
- Brush or roller selection
- Application technique
- Care of brushes for paint & varnish

**Achievement Criteria**

- Performance** The learner will apply typical paints, varnishes and coatings using brush and roller techniques.
- Conditions** The learner will require:
- Painting tools and equipment.
 - Assorted coatings.
 - Assorted substrates or vessel components.
- Criteria** The learner will be evaluated on:
- Appropriate product and tools selection
 - Preparation
 - Technique
 - Participation in the finishing exercise



Line (GAC): P **FINISHING AND PAINTING**
Competency: P7 **Brush-Apply Gloss Paints and Varnishes**

Objectives

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

- Describe brush and roller techniques to achieve high gloss paint finishes on all substrates.
- Describe brush and roller techniques to achieve gloss varnish finishes on wood.
- Identify high end coatings.

LEARNING TASKS

1. Describe brush and roller techniques to apply high gloss paints by hand

2. Describe brush and roller techniques to apply high gloss varnish to joinery and brightwork

3. Identify high end coatings

CONTENT

- Preparation techniques for paint
- Conventional enamel type paints
- Multi-component paints
- Brushes
- Rollers
- Painting techniques

- Preparation techniques for varnish
- Varnishes and additives
- Brushes for varnish
- Varnishing techniques

- Urethanes
- Lacquer
- Stains
- Water-based

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Level 3

Marine Service Technician



Line (GAC): D **TECHNOLOGY AND DESIGN**
Competency: D5 **Describe Wood Vessel Construction**

Objectives

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

- Describe the components and construction procedures for building wood vessels.

LEARNING TASKS

1. Describe the common configurations of traditional wood vessel structures
2. Describe the common methods for building wood hull structures
3. Describe the common methods for building wood decking and house structures
4. Describe cold-molded construction methods

CONTENT

- Materials used for backbone structures
- The components of backbone structures
- Steps in backbone construction
- Materials used for planking
- Function of planking
- Steps in planking construction
- Types of hull planking
- Materials selection
- Function of the components
- Steps in decking and house construction
- Covering and sheathing materials
- Materials for cold-molding
- Construction techniques



Line (GAC): **D TECHNOLOGY AND DESIGN**
Competency: **D6 Describe FRP Vessel Construction**

Objectives

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

- Describe the various methods for producing composite vessels.
- Describe the manufacturing sequence.

LEARNING TASKS

1. Describe the common fabrication alternatives for producing FRP vessels

2. Describe the lay-up procedures used in the production manufacturing

3. Describe the fabrication and assembly sequence of small to mid-sized vessels

4. Describe specialty manufacturing processes for producing composite vessels

CONTENT

- Female molded production boats
- Male molded one-off hulls
- Future repair considerations

- Mold preparation
- Gel coating
- Material lay-up
- Core installation
- Thickness zones

- Production lay-up
- Reinforcing structures
- Liners, bulkheads and shelves
- Hull/deck assembly
- Future repair considerations

- Vacuum bagging
- Vacuum assisted infusion
- Prepreg materials
- Post curing
- Future repair considerations



Line (GAC): **D TECHNOLOGY AND DESIGN**
Competency: **D8 Perform Lofting Operations**

Objectives

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

- Describe the procedures to lay out and fair hull lines to scale.
- Describe the development of patterns for structural members.
- Describe technological advancements in lofting.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Describe the procedure to fair the hull lines full size on a loft floor from a scale blueprint and table of offsets 2. Describe how to plot full size construction details 3. Describe how auxiliary views and the true shapes of curved surfaces are developed from the faired lines plan 4. Describe the advancement of lofting techniques using computer programs | <ul style="list-style-type: none"> • Reasons for lofting • Tools & equipment • Procedure for lofting • Concept of fairness • Backbone structure • Plank reduction • Rabbet development • Transom • Harpins • Square sections • CAD • 3D modelling • CNC produced components |
|--|--|

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): F TOOLS AND EQUIPMENT
Competency: F3 Use Stationary Power Tools

Objectives

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

- Use, maintain and adjust common stationary power tools.

LEARNING TASKS

1. Identify stationary power tools

2. Use appropriate stationary power tools

3. Perform basic care of stationary power tools, and change cutters, blades, etc

CONTENT

- Safety considerations
- Table saws
- Band saws
- Planer
- Jointer
- Mitre saw
- Drill press
- Sanders
- Bench grinder

- Tool selection
- Safety considerations
- Table saws
- Band saws
- Planer
- Jointer
- Mitre saw
- Drill press
- Sanders
- Bench grinder

- Routine maintenance
- Dust control
- Blade selection
- Blade changing
- Adjustments
- Lock out procedure

**Achievement Criteria**

- Performance** The learner will demonstrate the commonly used stationary power tools used in boatyard workplaces, their operation, maintenance and adjustment.
- Conditions** The learner will require:
- Stationary power tools.
 - Stock materials to demonstrate tool operation.
- Criteria** The learner will be evaluated on:
- Safety pre-checks.
 - Technique.
 - Accuracy.
 - Participation in the various cutting exercises.



Line (GAC): **I** **WOODWORK**
Competency: **I2** **Perform Structural Repairs**

Objectives

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

- Describe procedures to repair or replace structural members and planking in traditional wood vessels.

LEARNING TASKS

1. Describe repair methods for structural components

2. Describe steam bending operations

3. Describe repair procedures to damaged backbone structures, longitudinals and deck beams

4. Describe repair procedures to damaged hull planking, decks and house structures

CONTENT

- Frames
- Planking
- Backbone
- Decking
- Material selection
- Safety considerations
- Frame bending
- Plank bending
- Bending jigs
- Compression straps
- Timing
- Steam boxes
- Steam generators
- Damage assessment
- Repair considerations
- Fastener removal
- Selecting materials, cutting, bending and fitting replacement structures
- Damage assessment
- Repair considerations
- Selecting materials, cutting, bending and fitting replacement structures

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **J** **COMPOSITE**
Competency: **J1** **Fabricate FRP Tooling**

Objectives

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

- Describe the materials and processes for simple tooling.
- Fabricate a simple plug, mold and produce a composite part.

LEARNING TASKS

1. Describe the basic design considerations for building plugs and molds

2. Fabricate a simple plug

3. Fabricate an FRP mold from the plug fabricated in (2)

4. Lay up a structure using the FRP mold fabricated in (3)

5. Describe elastomeric tooling and casting techniques

CONTENT

- Part shape & draw angles
- Single and multi-component molds
- Shop conditions
- Plug reinforcing
- One-off molds
- Material selection
 - Plaster
 - Clay
 - FRP
 - Wood
 - Foam
- Material effect on cure
- Finishing materials
- Polishing procedures
- Release agents
- Handling and storage
- Release agents
- Gel coat or paint surfaces
- Lay up materials, resins/reinforcements
- Lay up sequence
- Stiffening alternatives
- Curing molds
- Mold storage
- Mold release
- Material choices for finish & structure
- Lay up sequence
- Part curing
- Part release & trimming
- Silicone & latex molds
- Urethane, epoxy & polyester casting compounds

**Achievement Criteria**

- Performance** The learner will fabricate a simple plug, make a mold from the plug and produce a composites part from the mold.
- Conditions** The learner will require:
- Materials for plug fabrication.
 - Composites resins and reinforcements.
 - Tools for composites layups.
- Criteria** The learner will be evaluated on:
- Preparation.
 - Appropriate material selection.
 - Technique.
 - Participation in the tooling fabrication exercise.

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria



Line (GAC): **J** **COMPOSITE**
Competency: **J2** **Repair FRP Structures**

Objectives

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

- Repair or renew/rebuild damaged composite reinforcing and stiffening members.

LEARNING TASKS

1. Assess structures for failure

2. Repair and renew secondary bonds of bulkheads, floors, stringers, shelves, engine beds, etc

3. Rebuild rotten stringers or engine beds

4. Rebuild rotten transom stiffeners

CONTENT

- Inspection techniques
- Types of stiffeners
- Size & location of stiffeners
- Delamination
- Ruptured stiffeners

- Bulkhead attachment
- Secondary bonding materials
- Failures against hull
- Failures on wood surfaces
- Use of fasteners

- Structural & non-structural cores
- Mounting fittings
- Rules for laminate thickness
- Design considerations

- Assessing rot damage in transom core
- Determining repair options
- Removing damaged materials
- Fittings & I/O cut-outs
- Re-lamination
- Refinishing

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): J **COMPOSITE**
Competency: J4 **Repair FRP Rudders and Stabilizers**

Objectives

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

- Repair FRP rudders and stabilizers.

LEARNING TASKS

1. Identify procedures to remove the FRP rudders and stabilizers

2. Assess internal damage to rudder assemblies

3. Remove and replace stock/tang assemblies

4. Rebuild laminate structure and fair rudders

CONTENT

- Hydraulic cylinders
- Tiller assemblies
- Quadrants
- Autopilot equipment
- Bearings and shafts

- Inspections
- Stock and tangs
- Rudder tubes, gussets & bearings
- Laminate damage
- Corrosion

- Removal methods
- Dimensional stability

- Relamination techniques
- Trailing edge fairness
- Dimensional stability
- Fairing
 - Template creation
 - Symmetrical foil shapes
 - Fair to templates

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **J COMPOSITE**
Competency: **J6 Perform Vacuum Bag Laminating**

Objectives

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

- Describe vacuum bag techniques for laminating single skin and cored structures.

LEARNING TASKS

CONTENT

<ol style="list-style-type: none"> 1. Describe the advantages of vacuum bagged FRP construction 2. Identify system components and maintain vacuum delivery system 3. Describe procedures for vacuum bagging a non-cored molded composite component 4. Describe additional requirements of bonding cores and vacuum bagging cored laminates 	<ul style="list-style-type: none"> • Resin/glass ratios • Choice of materials • Stiffness considerations • Operator cleanliness • Reduced VOCs • Vacuum pumps • Lines, valves, gauges, tanks, regulators, QD couplings, etc. • Resin traps and vacuum transfer equipment • Fabricating processes, wet/dry bagging, infusion • Resin and reinforcement selection • Bag material types • Sealant, bleeder & breather materials • Peel plies, flow media, release plies • Leak detection equipment • Core material selection & configuration • Core preparation • Bonding and installation techniques
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Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **K** **MECHANICAL SYSTEMS**
Competency: **K3** **Remove and Install Engines**

Objectives

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

- Assist in removal and installation of engines.

LEARNING TASKS

1. Plan for engine removal or replacement

2. Assist in selection, set up and use of engine lifting equipment

3. Assist in removal and replacement of engines

4. Describe the process for new installations

CONTENT

- Removal strategy
 - Inboard, outboard and I/O considerations
- Surface protection
- Bracing and lifting gear
- Identification
 - Labelling
 - Photographs
- Tackle safety ratings
- Cranes
- Chain hoists & come-alongs
- “A” frames & “C” frames
- Dollies
- Disconnecting engine
- Flood/fire prevention
- Safety procedures for lifting
- Clean up
- Re-installation
- Templates
- Engine beds
- Intake and exhaust

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute’s Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **K MECHANICAL SYSTEMS**
Competency: **K4 Perform Engine Pre-Start Inspection**

Objectives

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

- Identify and describe commonly used lubricants.
- Check lubricant fluid levels.
- Inspect engine for readiness to start and run

LEARNING TASKS

1. Describe the properties and applications of common lubricants

2. Check lubricant fluid levels in engines, transmissions and hydraulic equipment

3. Check engine for readiness in advance of starting up

CONTENT

- Engine oils & oil selection
- Hydraulic oils
- Outdrive oils
- Break-in oils & additives
- Greases

- Engine oil level
- Transmission oil level
- Hydraulic oil level
- Outdrive oil level

- PTO and accessory belts
- Water strainer & seacock
- Coolant levels and hoses
- Fuel system valves & lines
- Batteries, cables and switches
- Engine room tidiness

Achievement Criteria

- Performance** The learner will inspect marine engines, transmissions, fuel and cooling systems for readiness to start up.
- Conditions** The learner will require:
- Tools.
 - Access to marine engines.
 - Engine and drive train fluids.
- Criteria** The learner will be evaluated on:
- Appropriate fluid and tool use.
 - Completion of inspection checklist.
 - Participation in the inspection exercise.



Line (GAC): **K** **MECHANICAL SYSTEMS**
Competency: **K5** **Service Marine Engine Components**

Objectives

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

- Perform routine servicing procedures on inboard engine systems.
- Describe engine and transmission oil servicing.
- Describe lubrication of mechanical components.

LEARNING TASKS

1. Inspect and service combustion air components

2. Inspect and service cooling system components

3. Inspect exhaust system components

4. Inspect serviceable components of the fuel system

5. Service gasoline engine ignition systems

6. Describe servicing procedures to replace engine oil and filters

CONTENT

- Air supply ductwork
- Air filters & flame arresters
- Thru-hull and sea cock operation
- Water strainers & filters
- Water pump operation and impeller
- Engine zincs
- Cooling system hoses, hose clamps, thru hulls
 - Pressure testing
- Heat exchanger
- Exhaust system testing procedures
- Exhaust hoses, mufflers, check valves, thru-hulls
- Fuel tank problems
- Fuel lines and shut-off valves
- Gasoline and diesel fuel filters
- Fuel pump operation
- Bleeding fuel systems
- Inspections
- Spark plugs
- Ignition components
- Bilge blowers
- Lubricant and fluid level check
- Oil and filter change
- Oil removal techniques
- Oil disposal
- Oil contamination
- Oil analysis
- Lubrication servicing schedules
- Warranty implications



- | | |
|--|---|
| 7. Describe transmission fluid and filter service | <ul style="list-style-type: none"> • Transmission oils • Servicing procedures • I/O and gear transmission • Transmission fluid coolers |
| 8. Describe lubrication of moving parts and servicing procedures | <ul style="list-style-type: none"> • Assessing mechanical components for lubrication • Selecting appropriate oils & greases • Applying oils & greases to mechanical components |
| 9. Inspect drive belts | <ul style="list-style-type: none"> • V belts • PTO belts • Serpentine belts |

Achievement Criteria

Performance The learner will inspect marine engines, transmissions, fuel and cooling systems for readiness to start up.

Conditions The learner will require:

- Tools.
- Access to marine engines.
- Engine and drive train fluids.

Criteria The learner will be evaluated on:

- Appropriate fluid and tool use.
- Completion of inspection checklist.
- Participation in the inspection exercise.

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **K MECHANICAL SYSTEMS**
Competency: **K6 Service Engine Controls, Alarms and Gauges**

Objectives

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

- Test and describe the adjustment of mechanical engine controls.
- Identify the source of engine alarm and gauge failure.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Test mechanical engine controls for proper operation
 2. Describe routine adjustment for correct operation of mechanical engine controls
 3. Identify source of engine alarm system failure
 4. Identify sources of gauge failure | <ul style="list-style-type: none"> • Mechanical throttle controls • Transmission shifters • Choke, diesel shut off, decompression controls, trolling valves
 • Mechanical throttle controls • Transmission shifters • Choke, diesel shut off, decompression controls and trolling valves
 • Senders and alarm types • Cooling system overheating. • Exhaust system overheating. • Transmission • Oil pressure • Fuel pressure
 • Engine gauges <ul style="list-style-type: none"> ○ Tachometers ○ Temperature ○ Oil pressure ○ Hour meter • Fuel system gauges |
|--|--|

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **K MECHANICAL SYSTEMS**
Competency: **K11 Service Engine Starting and Charging Systems**

Objectives

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

- Describe engine starting equipment.
- Describe servicing procedures for engine driven alternators and charging equipment.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Describe servicing procedures for alternators
 2. Describe servicing procedures for starters and starter solenoids
 3. Describe servicing procedures for engine starting circuits | <ul style="list-style-type: none"> • Alternator function • Alternator types • Troubleshooting techniques
 • Starter function • Starter types <ul style="list-style-type: none"> ○ Solenoids ○ Motors • Troubleshooting techniques • Ignition and starter switches • Starting circuit solenoids • Troubleshooting starter circuit wiring |
|--|--|

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **L ELECTRICAL SYSTEMS**
Competency: **L3 Install & Service DC Power Supply and Distribution Systems**

Objectives

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

- Describe marine battery installations.
- Replace and service marine batteries.
- Assist in the installation of DC power supply systems.
- Assist in the lay out, installation and troubleshooting of DC power distribution systems.

LEARNING TASKS

CONTENT

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Describe battery capacity, performance and selection for marine applications
 2. Describe hazards associated with batteries
 3. Describe DC power requirements
 4. Assist in the installation of batteries
 5. Assist in the installation of charging equipment
 6. Describe alternate power sources
 7. Perform basic battery testing and servicing | <ul style="list-style-type: none"> • Battery capacities • Battery types • Technological advancements • Chemistry & cycling • Applications and selection considerations
 • Lifting & carrying • Hydrogen gas explosions • Acid spills • “Dead” shorts
 • Typical loads • Calculating loads • Storage capacity • Charging requirements
 • Selection and application • Installation considerations <ul style="list-style-type: none"> ○ Location ○ Ventilation ○ Boxes ○ Tie-downs • Terminals and cable installation • Alternators • Chargers • Switches and relays
 • Solar panels • Wind generators • Fuel cells
 • Hydrometer use • Load and capacitance |
|---|---|



8. Describe common reasons for battery discharge and failure
 - Topping up wet cells
 - Cleaning terminals
9. Assist in the selection and installation of DC distribution systems
 - Overcharging
 - Sulphating
 - Surface shorting
 - Corrosion and poor connections
 - Distribution panels
 - Circuit protection
 - Switching
 - Device layout
 - Labelling
 - Conductor sizing
 - Routing, bundling and securing conductors
 - Grounding
 - Testing and troubleshooting

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.

**Achievement Criteria**

Performance	The learner will perform procedures for installing load-bearing fittings on the deck or hull of FRP, wood or metal vessels.
Conditions	The learner will require: <ul style="list-style-type: none">• Tools.• A selection of typical marine hardware.• Marine substrates.
Criteria	The learner will be evaluated on: <ul style="list-style-type: none">• Determination of load.• Appropriate selection of materials.• Appropriate location.• Participation in the installation exercise.



Line (GAC): **N** **INSTALLATIONS**
Competency: **N2** **Install Thru-Hulls and Underwater Equipment**

Objectives

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

- Select and install thru-hull fittings and underwater equipment.

LEARNING TASKS

1. Identify and select fittings commonly used near or below the waterline

2. Identify fittings that have deteriorated beyond safe use

3. Install surface mount and flush mount thru-hull fittings

4. Assist in the installation of miscellaneous underwater fittings and fasteners

CONTENT

- Surface mount thru-hulls
- Flush mount thru-hulls
- Transducers & other underwater fittings
- Compatibility of metal fittings and fasteners
- Safety and valve installation
- Corrosion or damage to underwater fittings
- Locating position for thru-hulls
- Hull structure and backing plates
- Installation procedures
 - Material selection
 - Corrosion control
 - Single skin composite structure
 - Cored composite structure
 - Wood hulls
 - Steel and aluminum hulls
- Transducers
- Trim tabs
- Lights
- Hull control anode

**Achievement Criteria**

Performance The learner will install appropriate thru-hull fittings in composite, wood and metal hull materials.

Conditions The learner will require:

- Tools.
- Thru-hull fittings.
- Marine substrates and bedding compounds.

Criteria The learner will be evaluated on:

- Preparation of substrate.
- Appropriate selection of backing materials, bedding compounds, and tools.
- Accurate placement (for load and function).
- Participation in the installation exercise.

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **N** **INSTALLATIONS**
Competency: **N5** **Describe Propane Distribution Systems**

Objectives

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

- To describe the safe installation of propane tanks and associated supply lines.

LEARNING TASKS

1. Describe basic properties of propane

2. Describe the installation of propane tanks and supply lines

3. Describe the basic requirements for gas installations

CONTENT

- Density
- Flammability
- Odour
- Pressure
- Safety

- Tank and connection locations
- Propane tank containment and venting
- Piping & distribution lines
- Regulators & pressure valves
- Solenoids, detectors and alarms
- Controls

- Regulatory bodies
- Installation requirements
- Insurance considerations and liability



Line (GAC): **N** **INSTALLATIONS**
Competency: **N6** **Install and Service Heating Systems**

Objectives

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

- Assist in the installation and servicing of typical vessel accommodation heating systems.

LEARNING TASKS

1. Describe common marine accommodation heating systems

2. Describe the installation and servicing procedures of heating systems

CONTENT

- Diesel, kerosene and solid fuel
- Propane
- Forced hot air
- Hydronic
- Cabin heaters

- Diesel, kerosene and solid fuel heater installation & troubleshooting
- Cabin heaters
- Forced hot air heater installation & troubleshooting
- Hydronic heating installation & troubleshooting

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): P **FINISHING AND PAINTING**
Competency: P9 **Prime and Fair Metals**

Objectives

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

- Prepare and prime metal surfaces for fairing application.
- Describe how to fair metal vessel surfaces.

LEARNING TASKS

1. Prepare and prime metal for fairing or finishing

2. Select fairing materials

3. Describe application of fairing materials

4. Seal fairing materials and/or prepare for topcoat application

CONTENT

- Metal preparation for priming and fairing operations above and below waterline
 - Steel
 - Aluminum
 - Lead
- Primers for steel
- Primers for aluminum
- Primers for lead
- Application techniques
- Fairing materials used for steel
- Fairing materials used for aluminum
- Fairing materials used for lead
- Application techniques.
- Fairing techniques
- Preparation of faired surfaces before coating
 - Steel
 - Aluminum
 - Lead
- Final preparation for topcoat

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Level 4

Marine Service Technician



Line (GAC): **B** **YARD MANAGEMENT**
Competency: **B1** **Apply Professional Boatyard Business Practices**

Objectives

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

- Describe the basics of business practices and procedures.
- Describe the basic principles of quality assurance systems.
- Access information related to professional standards.

LEARNING TASKS

CONTENT

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Describe the basic principles of boatyard economics
 2. Describe the key components and legal responsibilities of contracts
 3. Describe the estimating and work order process
 4. Describe the principles of quality assurance systems
 5. Describe the agencies that govern the construction of recreational craft and installation of marine equipment | <ul style="list-style-type: none"> • Company structure and operations • Relationships between sales, overheads, wages, materials costs, taxes, capital investment, profit, etc. • Wages and benefits, legal responsibilities of employer & employee, regulatory authorities
 • Contract types • Estimates & quotations • Responsibilities of yard & customer • Insurance relationships • Liens and formal dispute resolution
 • Repair estimates • Operating procedures • Steps in work flow • Record keeping
 • Objectives of QA • Customer satisfaction • Standards • Procedures • Training • Inspection & quality control • Record keeping • Warranties
 • Transport Canada • ABYC • National Marine Manufacturers Association (NMMA) |
|--|---|



6. Access manufacturers information

- Specification sheet
- Technical support
- Selection charts



Line (GAC): **B** **YARD MANAGEMENT**
Competency: **B2** **Describe Role of Surveyors and Insurance Adjusters**

Objectives

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

- To describe the working relationships and responsibilities of marine surveyors and insurance adjusters.

LEARNING TASKS

1. Describe the activities and responsibilities of the marine surveyor

2. Describe the process and procedures to be followed when vessel damage results in an insurance claim

CONTENT

- Roles of the surveyor when employed by insurance companies
- Roles of the surveyor when employed by boat owners
- Roles of the surveyor when employed by purchasers

- Role of the owner
- Filing of a claim
- Authority to repair
- Notification of surveyor
- Inspection of vessel
- Repair estimate
- Repair completion
- Claim settlement
- Release



Line (GAC): **B** **YARD MANAGEMENT**
Competency: **B3** **Manage Projects**

Objectives

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

- Describe the management of multi-stage repair projects.

LEARNING TASKS

1. Describe the elements of a project planning process

2. Describe project control process

3. Review completed projects and provide feedback

CONTENT

- Resources required
 - Labour
 - Materials
 - Shop space/conditions
- Scheduling
- Basic control mechanisms.
- Schedule preservation
 - Planned versus actual events
 - Updating timelines
 - Change-order
 - Personnel responsibilities
 - Contingencies
- Reporting progress/problems
- Feedback process
 - Unplanned work
 - Over-runs
 - Work process modifications
- Documentation
- Communications with management
- Scheduling considerations
- Lessons learned

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **C YARD PRACTICES**
Competency: **C1 Apply Environmental Protection Practices**

Objectives

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

- Apply the principles of environmental protection practices in the workplace.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Apply environmental protection practices
 2. Identify regulatory agencies responsible for enforcing environmental regulations | <ul style="list-style-type: none"> • Best Management Practices program • Environmental containment • Record keeping • Training
 • Federal agencies • Provincial agencies • Municipal authorities |
|--|--|

Achievement Criteria

Performance The learner will develop an environmental protection site plan for an active boat service yard identifying key elements of the facility that relate to environmental protection and hazardous materials storage.

- Conditions** The learner will require:
- A scenario requiring a boatyard material storage unit
 - A site map of an existing facility
 - Specifications on type of hazardous materials and waste
 - References for regulatory information

- Criteria** The learner will be evaluated on:
- Environment and safety risk assessment
 - Consideration of hazard and safety requirements
 - Appropriate containment plan
 - Appropriate placement and identification relative to the rest of the facility/buildings
 - Hazards and safety requirements
 - An overall design that fits the purpose



Line (GAC): C YARD PRACTICES
Competency: C3 Identify the Consequences of Vessel and Engine Submersion

Objectives

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

- Identify the damage associated with vessel submersion and salvage and repair considerations.
- Identify the consequences and repair considerations of engine submersion.

LEARNING TASKS

1. Identify types of damage to submerged vessels

2. Describe repair considerations to submerged vessels

3. Describe the repair considerations to submerged engines

CONTENT

- Salt/fresh water
- Mechanical
- Electrical
- Structural
- Interior

- Cost/value considerations
- Repairers warranty limitations

- Lifting the engine
- Draining & restarting
- Preservatives
- Requirements for rebuilding
- Electrical components



Line (GAC): **G MATERIALS**
Competency: **G3 Use Thermoplastics**

Objectives

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

- Identify common thermoplastic materials.
- Perform basic machining, forming and bonding techniques.

LEARNING TASKS

1. Identify and describe common thermoplastic materials and their properties

2. Perform basic machining operations in thermoplastics

3. Perform bonding and forming procedures for thermoplastic components

4. Describe the installation of thermoplastic windows

CONTENT

- Acrylic
- Polycarbonate
- PTFE
- Polyethylene
- Nylon
- Acetal
- Bearing materials
- Handling & storage of thermoplastics

- Cutting, drilling and routing

- Forming options
- Bonding & sealing
- Bending limitations
- Shaping and machining
- Fastening
- Sealing
- Annealing

Achievement Criteria

Performance The learner will drill, cut, and fasten typical thermoplastic materials used in the marine workplace.

Conditions The learner will require:

- A representative sample of common thermoplastic materials.
- Stock thermoplastic material.
- Tools and equipment.
- Adhesives, fasteners, and cleaners.

Criteria The learner will be evaluated on:

- Appropriate selection of materials.
- Technique.
- Participation in the machining and bedding exercise.



Line (GAC): I **WOODWORK**
Competency: I6 **Perform Cold Molding**

Objectives

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

- Describe the construction techniques and repair procedures for cold molded wood construction.

LEARNING TASKS

1. Describe the principles of cold molded construction
2. Describe the methods of cold molded construction
3. Describe the repair considerations to cold molded structures

CONTENT

- History & development
- Design principles
- Monocoque construction
- Comparison with traditional materials
- Adhesives
- Sheathing techniques
- Vacuum bagging
- Appropriate wood types
- Planking methods
- Framing options
- Frameless construction
- Safety
- Mold construction
- Materials preparation
- Planking lay up
- Completion and fairing
- Damage assessment
 - Surface damage
 - Structural damage
- Rot repair
- Surface finishing considerations

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): I **WOODWORK**
Competency: I7 **Perform Wood Laminating**

Objectives

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

- Describe wood lamination operations.

LEARNING TASKS

1. Describe applications and reasons for laminated wood structures

2. Describe methods for laminating wood components

3. Describe the vacuum bagging techniques for wood lamination

4. Describe the method of replicating laminated components

CONTENT

- Beams
- Spars
- Frames
- Keels
- Stems
- Knees

- Selecting woods
- Adhesives
- Jig making
- Clamping
- Cleaning/finishing

- Equipment & materials
- Jigs
- Processes & problems

- Appropriate applications
- Jigs
- Bladder forming

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **I** **WOODWORK**
Competency: **19** **Sheath Wood Structure with Composite Materials**

Objectives

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

- Sheath wood structures with a gloss epoxy/fabric layup.
- Sheath wood structures with a utility polyester/fabric layup.

LEARNING TASKS

1. Sheath a finished wooden component with epoxy resin and fibreglass cloth to produce a clear sealed cosmetic finish

2. Sheath a wooden structure with polyester resin and a mat/cloth lay-up to reinforce and seal the component

CONTENT

- Surface preparation
- Sealing, laminating & curing procedures
- Resin & reinforcement choices
- UV protection & surface finishes

- Suitability for sheathing
- Surface filling & fairing
- Sealing, laminating & curing procedures
- Lay-up schedule & procedures
- Filling & fairing
- Finish options

Achievement Criteria

Performance The learner will sheath wood with epoxy/fabric and polyester/glass coverings.

Conditions The learner will require:

- Raw wood structures suitable for sheathing.
- Composites resins and reinforcements.
- Tools and equipment.

Criteria The learner will be evaluated on:

- Site and surface preparation.
- Appropriate selection of materials.
- Technique.
- Participation in the sheathing exercise.



Line (GAC): J **COMPOSITE**
Competency: J7 **Repair High Performance RFP Structures**

Objectives

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

- Describe procedures for repairing high performance FRP structures.

LEARNING TASKS

1. Describe the characteristics of high performance materials and manufacturing techniques

2. Describe repair procedures for damage to high performance structures

3. Describe vacuum and hot bonder techniques for repair work

CONTENT

- Carbon, aramid and other fabrics
- Epoxy & vinyl resin systems
- Vacuum and pre-preg construction
- Fabric wet-out systems
- Hot bonders

- Grinding carbon & aramid fibre
- Tool considerations
- Variations in taper
- Dealing with cores
- Materials preparation
- Lay-up considerations

- Equipment options
- Sealing the surface
- Bleeders & peel ply
- Lamination materials & orientation
- Post curing

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **M ELECTRONICS**
Competency: **M1 Install Basic Electronics and Networks**

Objectives

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

- Assist in the installation and removal of basic marine electronics.

LEARNING TASKS

1. Describe marine electronics

2. Assist in the installation and removal of basic marine electronics

3. Describe NMEA data interfacing

CONTENT

- Theory
- Cabling
- Ground planes
- Electromagnetic Interference (EMI)
- Instrumentation
- Power supply considerations

- Antennas
- Displays
- Black boxes
- VHF radios
- AIS
- Radar
- Transducers/senders
- Heading sensors

- NMEA 0183
- NMEA 2000
- Connectors
- Cabling

Achievement Criteria

- Performance** The learner will plan and mockup an NMEA 2000 or co-axial connector electronic installation.
- Conditions** The learner will require:
- Electronic hand tools.
 - Testing equipment.
 - Cabling, connectors, and electronic devices appropriate to the exercise.
- Criteria** The learner will be evaluated on:
- Appropriate layout and placement of equipment.
 - Proper connections.
 - Conformance to ABYC and NMEA standards.



Line (GAC): P **FINISHING AND PAINTING**
Competency: P3 **Mark and Mask Waterlines and Stripes**

Objectives

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

- Describe marking and masking procedures for hull stripes.
- Prepare surface.
- Use appropriate protective masking techniques in preparation for sprayfinishing.

LEARNING TASKS

1. Describe procedures for measuring, marking and masking hull stripes

2. Describe masking hulls and decks for painting

CONTENT

- Waterlines, given bow and stern positions
- Boot lines and cove stripes of constant visual width
- Curved hull stripes and graphics
- Fine line tapes
- Masking machines
- Plastic and paper sheeting
- Masking considerations for spray painting
- Surface preparation

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): P **FINISHING AND PAINTING**
Competency: P4 **Prep and Prime for Multi-Component Topcoats**

Objectives

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

- Describe surface preparation for topcoat applications.

LEARNING TASKS

1. Identify materials to prepare surfaces for high-end finishing

2. Describe procedures for preparing surfaces for high-end finishing

CONTENT

- Substrate considerations
 - FRP
 - Metals
 - Plastic
- Priming materials
- Fairing materials
- Sealing materials
- Substrate considerations
- Adhesion testing
- Paint compatibility
 - Hardware considerations
- Surface cleaning
 - Sanding options
 - Priming
 - Fairing
- Priming for topcoat
- Final sanding

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): P **FINISHING AND PAINTING**
Competency: P5 **Spray Multi-Component Topcoats**

Objectives

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

- Describe multi-component paint systems.
- Describe spray application methods for multi-component paint systems.

LEARNING TASKS

1. Describe multi-component paint systems and their advantages and disadvantages
2. Describe the application conditions required for spraying topcoat
3. Describe surface preparation
4. Describe the methods of spray application for multi-part paint systems

CONTENT

- Epoxy
- Polyurethane
- Base/clear
- Water borne
- Site preparation
- Safety considerations
- Temperature & moisture levels
- Ventilation
- Outside work
- Cleaning
- FRP, Aluminum and Steel surface preparation
- Containment
- Masking materials
- Safety equipment & procedures
- Topcoat equipment & procedures
 - Troubleshooting paint films and equipment
- Measuring & mixing
- Spraying procedures
- Additives
- Non-skid surfaces

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): P **FINISHING AND PAINTING**
Competency: P6 **Repair Multi-Component Topcoats**

Objectives

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

- Describe the repair procedures for damaged high-gloss multi-component coatings.

LEARNING TASKS

1. Describe techniques used to identify various paint types

2. Describe repair procedures

CONTENT

- Visual inspection
- Historical records
- Solvent resistance
- Adhesion testing
- Removal methods
- Primers
- Fillers & fairing options
- Topcoat spray techniques specific to repairs
- Sanding & polishing
- Masking techniques for repairs
- Colour matching
- Finishing options

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute's Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Line (GAC): **Q TENDERS**
Competency: **Q2 Install and Service Cranes, Davits and Hoists**

Objectives

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

- Assist in the installation and service of lifting systems.

LEARNING TASKS

1. Describe lifting systems

2. Assist in selection and installation of lifting systems

3. Assist in servicing lifting systems

CONTENT

- Applications
- Types
 - Mast & boom
 - Cantilever types
 - Twin stern davits
- Manual, electric & hydraulic winches
- Load calculations
- Structural considerations
- Design considerations
 - Location
 - Stability
- Installation procedures
- Wear or damage
- Routine maintenance
 - Lubrication
 - Compromised components

Note: This competency has been identified as a high level skill for which further training will occur on the job. MSTs specializing in this skill will be assessed in the workplace using Quadrant Marine Institute’s Advanced Competency Assessment Standards and Workplace Performance Report Criteria.



Section 4

ADVANCED WORKPLACE COMPETENCIES



The cornerstone of the Marine Service Technician apprenticeship lies within a close partnership with industry. Aside from in-class instruction, MST apprentices are expected to undergo training and assessment for six elective Advanced Workplace Competencies in order to be certified Marine Service Technicians.

As referred to throughout this document, these are competencies in the program outline that have been identified as high level skills – for which apprentices will receive on the job training and be assessed by their employer through Quadrant Marine Institute’s Advanced Competency Assessment Standards & Workplace Performance Report Criteria. Any six may be selected.

Refer to the list below for currently identified Advanced Workplace Competencies. As the MST program strives to reflect the needs and trends of industry, this list is not exhaustive but a living document that may change from time to time. For up to date information regarding the Advanced Workplace Competencies, please contact [Quadrant Marine Institute](http://www.quadrantmarineinstitute.com) for details.

- | | | | |
|-----|---|----|--|
| B3 | Manage Projects | L3 | Install & Service DC Power & Distribution Systems |
| C4 | Operate Power and Sail Vessels* | L4 | Install & Service AC Power & Distribution Systems |
| C5 | Operate Vessel Lifting & Maneuvering Equipment* | L5 | Install Alternative Power Sources* |
| D2 | Create Technical Drawings | M2 | Install Advanced Electronics* |
| D8 | Perform Lofting Operations | M3 | Install Advanced Electronic Networks* |
| H2 | Weld Marine Metals* | N2 | Install Thru-Hulls & Underwater Equipment |
| H3 | Fabricate with Marine Metals* | N3 | Install & Service Fresh Water Systems |
| H4 | Control Corrosion in Metals | N4 | Install & Service Waste Water Systems |
| I2 | Perform Structural Repairs | N6 | Install & Service Heating Systems |
| I3 | Perform Fairing & Cosmetic Operations | N7 | Install & Service Refrigeration & Air Conditioning Systems |
| I4 | Use Traditional Caulking Methods* | O1 | Install & Service Standing Rigging |
| I5 | Repair Teak Decking* | O2 | Install & Service Running Rigging |
| I6 | Perform Cold Molding | O3 | Step, Unstep and Store Masts* |
| I7 | Perform Wood Laminating | O4 | Install & Service Deck Hardware* |
| I8 | Perform Joinery * | O5 | Splice Lines* |
| J1 | Fabricate FRP Tooling | O6 | Tune Rigging* |
| J2 | Repair FRP Structures | O7 | Build Spars* |
| J3 | Repair Keel Impact Damage | O8 | Service & Repair Carbon Spars* |
| J4 | Repair FRP Rudders & Stabilizers | P2 | Apply Anti-Fouling Paints |
| J5 | Repair Osmosis Damage | P3 | Mark & Mask Waterlines & Stripes |
| J6 | Perform Vacuum Bag Laminating | P4 | Prep & Prime for Multi-Component Topcoats |
| J7 | Repair High Performance FRP Structures | P5 | Spray Multi-Component Topcoats |
| J9 | Repair Gel Coat Damage | P6 | Repair Multi-Component Topcoats |
| K3 | Remove & Install Engines | P7 | Brush-Apply Gloss Paints & Varnishes* |
| K5 | Service Marine Engine Components | P8 | Perform Detailing* |
| K6 | Service Engine Controls, Alarms & Gauges | P9 | Prime & Fair Metals |
| K7 | Service Steering Gear | Q1 | Service & Repair Inflatable Vessels* |
| K8 | Service Engine Mounts, Shafting & Alignment | Q2 | Install & Service Cranes, Davits & Hoists |
| K9 | Service Propellers | | |
| K10 | Install & Service Hydraulic Systems | | |
| K11 | Service Engine Starting & Charging Systems | | |

*Advanced competencies that are not detailed in the program outline as the training component for this will be addressed and assessed solely through the workplace. All other competencies have a theory component as detailed in the program outline with institutional-based learning assessment.



Section 5

TRAINING PROVIDER STANDARDS



Facility Requirements

Classroom Area

- Projection screen, multimedia projector, whiteboard or similar
- Seating and tables suitable for lecturing
- Compliance with all safety codes

Shop Area

- Meet all safety and fire, and environmental codes
- Good lighting
- Approved ventilation systems

Lab Requirements

- N/A

Student Facilities

- Hand wash facility, washroom facility.

Other

- Storage space for classroom and shop props.



Tools and Equipment: Level 1

Shop Equipment

Required

- Fire extinguishers
- 10" - ½" line
- Access to moored vessels
- Access to boatyard facility or simulation
- Access to jack stands
- Compressed air system

Shop (Facility) Tools

Standard Tools

- Tape measure
- Micrometer
- Vernier
- Digital weigh scales
- Callipers
- Liquid volume containers
- Standard thermometer
- Laser thermometer
- Air pressure gauge
- Slot screwdriver
- Robertson screwdriver
- Phillips screwdriver
- Awl
- Hack saw
- Carpenter's hand saw
- Coping saw
- Box wrench set
- Socket wrench set
- Allen key set
- Adjustable wrench
- Standard pliers
- Needle nose pliers
- Side cutters
- Wire crimper/stripper
- Utility knife
- Ball peen hammer
- Mallet
- Assorted resin mixing containers
- Stir sticks
- Shears
- Squeegee
- Laminate roller
- Sanding block
- Sander/polisher
- Buffing pads

Specialty Tools

- Die grinder
- Angle grinder
- Assorted grinding discs
- Space heater
- Multi-meter

Student Equipment (supplied by school)

- Eye protection
- Hearing protection
- Rubber gloves
- Dust mask

Student Tools (supplied by student)

- Respirator with VOC cartridge
- Coveralls
- Safety shoes



Tools and Equipment: Level 2

Shop Equipment

Required

- Compressed air system
- Air hose and fittings
- Drill press
- Band saw
- Belt sander

Shop (Facility) Tools

Standard Tools

- Straight edge
- Battens
- Caulking gun
- Portable drill
- High speed drill bits
- Hole saw kit
- Angle grinder
- Assorted grinding discs
- Assorted sanding blocks
- Long board
- Sander/polisher
- Sabre saw
- Siphon/gravity feed spray gun
- Assorted metalworking files
- Taps/dies
- Propane torch
- Multi-meter
- Polarity tester

Specialty Tools

- Propeller puller

Student Equipment (supplied by school)

- Eye protection
- Hearing protection
- Rubber gloves
- Dust mask

Student Tools (supplied by student)

- Respirator with VOC cartridge
- Coveralls
- Safety shoes



Tools and Equipment: Level 3

Shop Equipment

Required

- Compressed air system
- Air hose and fittings
- Drill press
- Band saw
- Belt sander

Shop (Facility) Tools

Standard Tools

- Straight edge
- Battens
- Caulking gun
- Portable drill
- High speed drill bits
- Hole saw kit
- Angle grinder
- Assorted grinding discs
- Assorted sanding blocks
- Long board
- Sander/polisher
- Sabre saw
- Siphon/gravity feed spray gun
- Assorted metalworking files
- Taps/dies
- Propane torch
- Multi-meter
- Polarity tester

Specialty Tools

- Propeller puller

Student Equipment (supplied by school)

- Eye protection
- Hearing protection
- Rubber gloves
- Dust mask

Student Tools (supplied by student)

- Respirator with VOC cartridge
- Coveralls
- Safety shoes



Tools and Equipment: Level 4

Shop Equipment

Required

- table saw
- band saw
- drill press
- ventilation system

Shop (Facility) Tools

Standard Tools

- assorted resin mixing containers
- stir sticks
- squeegee
- shears
- laminate roller
- sanding block
- sander/polisher
- buffing pads
- heat gun
- portable drill
- high speed drill bits
- hole saw kit
- angle grinder
- assorted grinding discs

Student Equipment (supplied by school)

- eye protection
- hearing protection
- rubber gloves

Student Tools (supplied by student)

- respirator with VOC cartridge
- coveralls
- safety shoes



Reference Materials

Required Reference Materials

- Marine Service Technician Training Resources: Quadrant Marine Institute Inc.
- American Boat and Yacht Council (ABYC): Standards and Technical Information Reports for Small Craft (available on disc or internet access)
- Transport Canada: TP 1332 Construction Standards for Small Vessels

Recommended Resources

- Transport Canada: www.tc.gc.ca
- ABYC: www.abycinc.org
- Quadrant Marine Institute: <http://www.quadrantmarine.com/>
- National Marine Electronics Association <https://www.nmea.org/>

Suggested Texts

- Calder, Nigel: Boatowner's Mechanical and Electrical Manual
- Calder, Nigel: Marine Diesel Engines: Maintenance, Troubleshooting, and Repair
- Calder, Nigel: Boatowner's Mechanical & Electrical Manual: How to Maintain, Repair, and Improve Your Boat's Essential Systems
- Calder, Nigel: Refrigeration for Pleasure Boats: Installation, Maintenance & Repair
- Colvin, Thomas E.: Steel Boatbuilding
- Collier, Everett: The Boatowner's Guide to Corrosion
- Dashew, Steve & Dashew, Linda: Offshore Cruising Encyclopaedia II
- Gougeon, Meade: Gougeon Brothers on Boat Construction: Wood & West System Materials
- Larsson, Lars & Eliasson, Rolf: Principles of Yacht Design
- Payson, Harold H.: Keeping the Cutting Edge: Setting & Sharpening Hand & Power Saws
- Pollard, Stephen F.: Boatbuilding With Aluminum
- Skene, Norman L. & Kinney, Francis S.: Skene's Elements of Yacht Design
- Vickers Industrial Hydraulics Manual
- Professional Boatbuilder Magazine, Brooklin ME USA: Professional Boatbuilder



Instructor Requirements

Occupation Qualification

The instructor must possess:

- Trade certification in MST (formerly MRT) or other marine related trade certificate, or a minimum of 10 years' trade experience working in the subject matter area.

Work Experience

A minimum of 10 years' experience working in the recreational marine industry.

Instructional Experience and Education

It is preferred that the instructor also possesses one of the following:

- Teaching experience in adult learning settings
- Diploma or certificate of completion in an adult education training program
- ABYC, NMEA, or other standards certifications applicable to their subject area



Appendices



Appendix A Previous Contributors

The Program Outline was prepared with the advice and direction of an industry steering committee convened initially by the Transportation Industry Career Development Association Members included:

- Jeff Adams Philbrook's Boatyard Ltd.
- Campbell Black Blackline Marine Inc.
- Peter Dahl West Coast Boatyard Association
- Ben Gartside Gartside Marine Engines Ltd.
- Drew Irwin Philbrook's Boatyard Ltd.
- Chuck MacKenzie Cherokee Mechanical Ltd.
- Glenn Spartz Volvo Penta Canada Inc.
- Steve Tyliakos Oceanos Marine Solutions Ltd.
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