SKILLEDTRADES BC

PROGRAM OUTLINE

Marine Service Technician

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MARINE SERVICE TECHNICIAN
PROGRAM OUTLINE

APPROVED BY INDUSTRY

OCTOBER 2017

Developed by
SkilledTradesBC
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.

Acknowledgements

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

- Campbell Black — Blackline Marine Inc.
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- Cameron Williams — Van Isle Marina

SkilledTradesBC 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
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

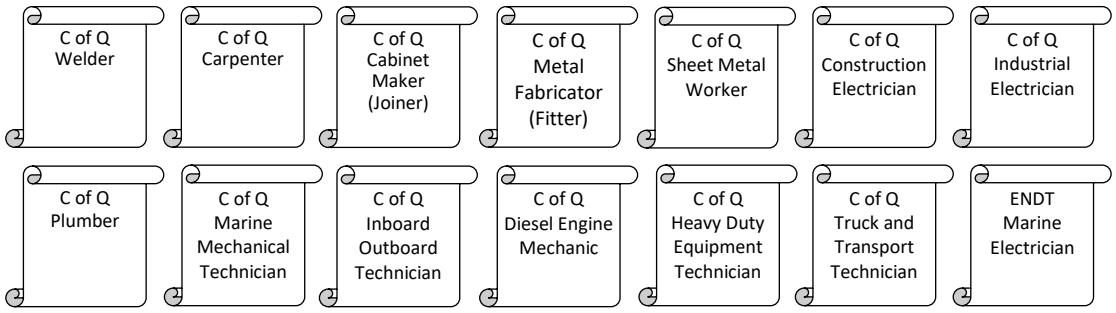
Marine Service Technician

Program 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, AW			
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 C4 AW	Operate Vessel Lifting and Maneuvering Equipment W C5 AW	
TECHNOLOGY AND DESIGN D	Define Trade Terminology and Concepts D1 1	Create Technical Drawings D2 1, AW	Describe Design Basics D3 2	Describe Principals of Powering D4 2	Describe Wood Vessel Construction D5 3	Describe FRP Vessel Construction D6 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 D7					Perform Lofting Operations D8				
			3					3		AW
	Perform Layout and Fitting Operations D9									
	2									
TRADE MATHEMATICS E	Apply Trade Math E1					Perform Measurement Operations E2				
	1					1				
TOOLS AND EQUIPMENT F	Use Hand Tools F1					Use Portable Power Tools F2				
	1					1				
	Use Stationary Power Tools F3					Use Compressed Air Delivery Systems F4				
			3				2			
	Use Spray Equipment F5					Maintain Workplace Electrical Equipment F6				
	2					1				
MATERIALS G	Select Wood Repair Materials G1					Select Composite Materials G2				
	1					1	2			
	Use Thermoplastics G3					Select Marine Metals G4				
				4			2			
	Select Fasteners G5					Use Adhesive and Bedding Compounds G6				
	2						2			
	Use Abrasive Materials G7									
	1									
MARINE METALS H	Drill and Cut Metals H1					Weld Marine Metals W H2				
		2								AW
	Fabricate with Marine Metals W H3					Control Corrosion in Metals H4				
					AW			3		AW

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

Program Overview

WOODWORK (I)

Competency	Code	W	1	2	3	4	AW
Assess Rot and Deterioration Damage	I1		1				
Perform Structural Repairs	I2				3		AW
Perform Fairing and Cosmetic Operation	I3					4	AW
Use Traditional Caulking Methods	I4	W					AW
Repair Teak Decking	I5	W					AW
Perform Cold Molding	I6					4	AW
Perform Wood Laminating	I7					4	AW
Perform Joinery	I8	W					AW
Sheath Wood Structure with Composite Materials	I9					4	

COMPOSITE (J)

Competency	Code	W	1	2	3	4	AW
Fabricate FRP Tooling	J1				3		AW
Repair FRP Structures	J2		1	2	3		AW
Repair Keel Impact Damage	J3			2			AW
Repair FRP Rudders and Stabilizers	J4				3		AW
Repair Osmosis Damage	J5			2			AW
Perform Vacuum Bag Laminating	J6				3		AW
Repair High Performance FRP Structures	J7					4	AW
Maintain Gel Coat Surfaces	J8		1				
Repair Gel Coat Damage	J9		1				AW

MECHANICAL SYSTEMS (K)

Competency	Code	W	1	2	3	4	AW
Identify Engine and Drivetrain Components	K1		1				
Describe Engine Room Layout and Ventilation	K2			2			
Remove and Install Engines	K3				3		AW
Perform Engine Pre-Start Inspection	K4				3		
Service Marine Engine Components	K5				3		AW
Service Engine Controls, Alarms and Gauges	K6				3		AW
Service Steering Gear	K7				3		AW
Service Engine Mounts, Shafting and Alignment	K8			2			AW
Service Propellers	K9			2			AW
Install and Service Hydraulic Systems	K10				3		AW
Service Engine Starting and Charging Systems	K11				3		AW

W = Competencies for which knowledge or skills are primarily acquired in the workplace.
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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	4	W AW
ELECTRONICS **M**	Install Basic Electronics and Networks M1	Install Advanced Electronics M2	Install Advanced Electronic Networks M3		
	4	W AW	W AW		
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 AW	2 AW	2 AW	3	3 AW
	Install and Service Refrigeration and Air Conditioning Systems N7					
	3 AW					
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 AW	2 AW	W AW	W AW	W AW	W AW
	Build Spars O7	Service and Repair Carbon Spars O8				
	W AW	W AW				

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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				AW	

Mark and Mask Waterlines and Stripes					
					P3
			4	AW	

Prep and Prime for Multi-Component Topcoats					
					P4
			4	AW	

Spray Multi-Component Topcoats					
					P5
			4	AW	

Repair Multi-Component Topcoats					
					P6
			4	AW	

Brush-Apply Gloss Paints and Varnishes					
					P7
	2			AW	

Perform Detailing					
W					P8
				AW	

Prime and Fair Metals					
					P9
		3		AW	

TENDERS

Q

Service and Repair Inflatable Vessels					
W					Q1
				AW	

Install and Service Cranes, Davits and Hoists					
					Q2
			4	AW	

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	**FINISHING AND PAINTING**	**6%**	**100%**	**0%**	**100%**
P9	Prime and Fair Metals		✓		
	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

Line (GAC): A SAFETY

Competency: A1 Apply Safe Work Practices

Objectives

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

- Describe WorkSafeBC standards.
- Apply safe work practices.
- Handle hazardous materials.
- Assess hazards and risks.

LEARNING TASKS	CONTENT

1. Describe WorkSafeBC standards	• Legal responsibilities
	  ○ Owners and employees
	  ○ Education and training
	  ○ Orientation processes
	• Reporting, inspections and investigations
	• WorkSafeBC assessment and penalty costs affecting employers

2. Apply safe work practices	• WorkSafeBC standards • Company policy, procedures and training • Hazard and risk identification and assessment • Harmful substances, health hazards and work environment controls • Personal protective equipment • Electrical systems • Overhead dangers • Working at heights • Working near water • Confined spaces • Temporary lighting and

3. Handle hazardous materials	• Effects of hazardous materials and harmful substances (toxins and dusts)
	• Workplace Hazardous Materials Information System (WHMIS - GHS)
	  ○ Labelling
	  ○ SDS
	  ○ Training
	• Hazards and risks
	• Safe handling, storage and disposal
	• Confined spaces
	  ○ Ventilation and respiration
	  ○ 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	CONTENT
1. Describe first response and second response procedures for fire emergencies	• First response to fire emergency • Second response to fire emergency
2. Describe fire extinguisher types, servicing and their use	• Extinguisher types & capacities • Extinguisher servicing • Extinguisher handling • Use of water on fires • Smothering fires
3. Describe procedures in case of serious workplace injury	• Injury & bleeding • Electrical shock • Hypothermia & drowning
4. Use fire extinguisher	• Supervised firefighting demonstration
5. Obtain certification in OFA Level 1	• 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.

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:

- Demonstrate a professional approach to work.
- Use workplace documents and forms to communicate workplace information.
- Use electronic media to communicate and to access workplace information.
- Describe marine repair industry structure.

LEARNING TASKS	CONTENT
1. Demonstrate required professional attributes	• Responsibility • Reliability • Conflict resolution • Appearance • Self awareness • Communication and customer relations • Timeliness • Handling of personal and privileged information • Record keeping and office paperwork • Organized, clean and neat work environment
2. Describe opportunities for advancement in the profession and the experience or training required	• Skill development, training and learning opportunities • Career paths

3. Use workplace documents and forms	• Technical manuals
	• Policy manuals
	• Catalogues and directories
	• Workplace forms
	  ○ Time and materials sheets
	  ○ Work orders
	  ○ QA forms
	  ○ Estimates
	  ○ Product labeling (SDS)
	• Requisitions
	• Photographic records keeping

4. Use electronic media	• Computer, tablets
	  ○ Marine specific applications
	• Scanner
	• Email
	• Web based information
	  ○ OEM data and manuals

LEARNING TASKS	CONTENT
5. Describe the nature and future trends of the marine repair industry	○ 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	CONTENT
1. Secure vessels at dockside	• Types of lines • Uses of lines • Common knots & hitches • Securing vessels • Shore power
2. Identify common haul-out equipment and compare their features (fit for purpose)	• Travel lifts • Marine ways • Vertical lifts • Trailers & ramps
3. Describe blocking placement for various vessel types and repair situations	• 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 blockiing 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	CONTENT
1. Define the terms used in hull definition	• Hull definition • Hull shapes & characteristics • Lines plan terminology
2. Describe the concept and the terms used in describing vessel tonnage	• Tonnage measure • Gross & net tonnage
3. Define the terms used in describing vessel performance	• Boat speed • Speed/length ratio • Hull speed • Boat motion • Roll, pitch & yaw
4. Define the terms used in the description and design of power vessels	• Powerboat types • Displacement hulls • Planing hulls • Propellers, nozzles & thrusters • Rudders • Anti-roll devices
5. Define the terms used in the description and design of sailing vessels	• Rigging terms • Rig types • Sail terminology
6. Describe concepts of aerodynamics and sailing rig design	• 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	CONTENT
1. Interpret technical drawings	• Use of scale drawings • Scale rules, imperial & metric • Views • 3-dimensional presentations • Exploded diagrams
2. Describe the concepts and terminology associated with lines plans.	• Lines plan terminology • Concept of fairness • Uses of the lines plan
3. Create simple 3-dimensional drawings	• 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	CONTENT
1. Perform basic mathematical operations manually and with an electronic calculator	• Basic operations (addition, subtraction, multiplication & division) • Units and conversions • Fractions • Equations • Powers • Percentages • Ratios • Proportions
2. Perform basic calculations	• Definition of terms • Calculations of specific gravity • Calculations involving density
3. Calculate areas	• Calculate areas of simple shapes • Calculate areas of complex shapes

4. Calculate volumes	• Calculate volume of solids of:
	  ○ Rectangular section
	  ○ Cylindrical section
	  ○ Triangular section

Line (GAC): E TRADE MATHMATICS

Competency: E2 Perform Measurement Operations

Objectives

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

- Select appropriate measurement tools common to the marineindustry.
- Use measurement tools to measure objects, liquids, pressures andtemperatures.

LEARNING TASKS	CONTENT
1. Describe the function and use of trade measurement tools	• Measurement terminology • Imperial and metric systems • Scales • Micrometers • Calipers • Laser measurement tools • Liquid volume measurement tools • Temperature measurement tools • Pressure measurement tools • Measurement tools

2. Perform measurement operations	• Liquids
	• Pressure
	• Objects
	  ○ Volume
	  ○ Surface area
	• Temperature

Achievement Criteria

Performance	The learner will perform measurement operations.
Conditions	The learner will require: • Measurement tools.
Criteria	The learner will be evaluated on: • Correct selection of tools for the operation. • Use and care of tool. • Accuracy of measurement. • Participation in the practical exercise.

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	CONTENT
1. Identify common hand tools	• Common hand tools • Woodworking tools • Tools for composite materials • Mechanics' tools • Electricians' tools
2. Select and use common hand tools	• Common hand tools • Woodworking tools • Tools for composite materials • Mechanics' tools • Electricians' tools
3. Perform basic tool care	• 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	CONTENT
1. Identify common portable power tools	• Power tools for woodwork • Power tools for composite materials • Power tools for metals • Electric power tools • Air power tools
2. Select and use common portable power tools	• Power tools for woodwork • Power tools for composite materials • Power tools for metals • Electric power tools • Air power tools
3. Demonstrate basic tool care	• 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	CONTENT
1. Identify components of various electrical distribution systems commonly found in a boatyard	• Voltages & phases • Panels, breakers & fuses • Plugs, receptacles & adapters • Ground fault interrupters
2. Describe fire and shock hazards related to electrical equipment	• Adequate insulation • Short circuits & ground faults • Water hazards
3. Maintain extension and equipment supply cords	• 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 marineapplications
- Select the appropriate wood materials for structural repair situations

LEARNING TASKS	CONTENT
1. Describe the basic properties of commonly used wood species	• How wood grows • Hardwoods & softwoods • Moisture content • Seasoning • Shrinkage • Defects • Rot resistance • Gluing characteristics • Availability
2. Identify commonly used woods by sight, grain, hardness and smell	• Hands on identification • Densities • Strengths • Durability
3. Describe the properties and grading system of plywood	• Structural properties of plywood • Wood species used in plywood • Grading • Composite wood
4. Describe the methods of grading, quantity estimating and pricing of woods	• Board measure • Moisture meters • Cutting & grading • Plywood size & grades • Estimating quantities required • Pricing
5. Select suitable wood species for the repairs of structural components	• 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	CONTENT
1. Identify marine resin types	• Polyesters, vinylesters, epoxies • Physical properties • Advantages & disadvantages
2. Describe the use of resin additives	• Catalysts, promoters, accelerators • Air drying additives • Fire retardants • Other additives • Fillers
3. Describe the properties of gel coats and their proper uses	• Uses for gel coat • Gel coat characteristics • Gel coat additives & pigments • Repairs
4. Describe the factors which influence optimal cure of resins	• Temperature • Moisture • Mixing ratios • Contaminants, sunlight, wind • Shelf life
5. Describe the function of fibres and fabric styles in composite structures	• Glass, Kevlar , carbon • Fibre, weaves & styles • Characteristics of reinforcement/resin composites • Handling & storage of reinforcements
6. Use appropriate resins and reinforcements	• Construction vs. repair requirements • Handling & storage • Technical literature

Line (GAC): G MATERIALS

Competency: G7 Use Abrasive Materials

Objectives

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

- Use abrasives and associated tools for marine applications.

LEARNING TASKS	CONTENT
1. Identify the composition and uses of abrasive materials and tools	• How abrasives work • Abrasive materials • Backing fabrics • Adhesive materials • Sizing compounds • Grading system • Belts, papers, discs • Abrasive polishing compounds • Sanders • Grinders • Polishers • Specialty tools
2. Use abrasive materials and tools for applications in wood, composites or metals	• Woodworking abrasives operations • Composites abrasives operations • Metal abrasives operations

Achievement Criteria

Performance — The learner will select and use abrasives and associated tools for marine applications with wood, metal or composite materials.

Conditions — The learner will require:

- A selection of abrasive tools and equipment.
- Materials for demonstrating their use.

Criteria — The learner will be evaluated on:

- Appropriate selection of abrasive type and grade for the task.
- Technique.
- Participation in coating preparation exercise.

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	CONTENT
1. Describe rot damage in wood	• Identification • Types of rot • Conditions leading to rot • Rot prevention • Rot removal and extent of repairs
2. Describe damage caused by marine organisms	• Identification • Marine borers • Vulnerable areas & typical damage • Prevention • Damage repair
3. Describe other forms of deterioration in wood	• 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	CONTENT
1. Describe methods for assessing damage to single skin laminates	• Visual inspection • Sounding • Grinding to expose laminates
2. Describe how laminate design will influence repair procedures	• Material types • Thickness/stiffness • Strength considerations • Shape & finish
3. Describe how surface preparation, materials choice and curing conditions influence the quality of a repair	• Eliminating damaged material • Grinding tapers • Resin/reinforcement options • Layup schedule & sequence • Curing conditions
4. Protect a boat's interior and exterior from damage or dust contamination while work is in progress	• Masking techniques • Ventilation/vacuuming • Clean up procedures
5. Describe how to create an environment that will provide optimal curing conditions for resins	• Temperature • Humidity • Wind, sunlight, contamination
6. Laminate, repair and re-surface a single-skin FRP structure	• 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 andrepair. • Resin, reinforcement materials and tools required to effect arepair.
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	CONTENT
1. Describe the common cosmetic problems of gel coated surfaces	• Manufacturing defects • Environmental exposure • Impact & stress
2. Clean gel coat surfaces	• Cleaner selection • Routine cleaning • Stain removal
3. Polish gel coat surfaces	• 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	CONTENT
1. Assess deteriorated gel coat surfaces and recommend appropriate repairs	• Surface evaluation • Limits to re-gel coating • Refinishing alternatives
2. Describe procedures for repairs to gel coat damage	• Damage assessment • Voids • Gouges & fastener holes • Colour matching • Fillers & additives • Application techniques • Sanding and finishing
3. Describe the repair procedures for damaged gel coat surfaces	• Preparation of repair area • Selecting and mixing resin and additives • Application techniques • Sanding and finishing
4. Describe repair procedures for damaged non- skid surfaces	• 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
1. Describe the function of marine engine cooling systems and their components	• Raw water cooling • Fresh water and heat exchangers • Keel cooling • Full flow valves
2. Describe the function of marine exhaust systems and their components	• Exhaust system layout • Dry exhaust • Wet exhaust • Sizing • Mufflers • Mixing elbows • Risers & anti-siphon devices
3. Describe the functions and components of fuel systems	• Fuel tanks • Line sizing and plumbing • Fillers & vents • Pumps & filters
4. Describe the use and function of engine gauges, warning alarms and instruments	• Tachometers, voltmeters, ammeters • Pressure & temperature gauges & alarms
5. Describe the components of gasoline engine fuel, ventilation and ignition systems	• Gasoline combustion air systems • Carburation • Electronic fuel injection • Gasoline ignition systems
6. Describe gasoline engine control systems	• Throttle, choke & gearshift controls
7. Describe the components and function of diesel combustion air and fuel systems	• Diesel combustion air systems • Diesel fuel systems • Turbochargers
8. Describe diesel engine control systems	• Throttle, pre-heating, shut-off, decompression and gearshift controls
9. Describe drive train types and configurations	• Inboard • Outboard • Direct drive • V-drive

	• Saildrives • Inboard/Outboard • Jet drives • Pod drives
10. Identify components of inboard drive train types	• 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	CONTENT
1. Select appropriate anti-fouling paint	• Marine fouling growth • Types of paint • Paint compatibility • Reading compatibility charts
2. Prepare and apply anti-fouling to new and previously painted hulls	• Preparing new hulls • Preparing previously painted hulls • Barrier coatings and primers • Paint thickness • Application techniques • Environmental concerns
3. Utilize appropriate paint stripping methods for removing anti-fouling	• Surface evaluation • Removing anti-fouling coatings by scraping • Using chemical paint strippers • Sanding • Media blasting techniques
4. Prepare metal surfaces (lead or iron keels) and the apply barrier coatings	• Cleaning, drying and preparing iron or lead keels for coating • Media blasting • Application of barrier coatings to iron & lead keels
5. Prepare aluminum hulls for anti-fouling coatings	• 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 hullform.
- Compare elements of hull design and testing methods.

LEARNING TASKS	CONTENT
1. Define the terminology used in describing basic hydrostatic principles	• Hydrostatics terminology
2. Describe the Archimedes Principle	• Laws that govern floating bodies • Applications in the workplace
3. Describe the righting moment and the stability curve	• 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
4. Describe coefficients of form	• 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 drivenvessels.
- Describe the procedure for selecting engines, gear ratios and propellers.

LEARNING TASKS	CONTENT
1. Describe the nature of resistance and the forces that limit speed	• Components of resistance
2. Describe the different hull types required for different speeds	• Displacement hulls • Planing hulls • Concept of hull speed
3. Interpret engine performance curves and compare engine rating	• Performance curves • Duty cycles • Power prediction methods
4. Describe the basic propeller types, characteristics and dimensions	• Propeller terminology • Propeller types • Propeller selection • Vibration problems
5. Compare propeller dimensions to engine power and speed	• Propeller selection
6. Describe shaft selection and bearing spacing	• Propeller shaft sizing • Propeller shaft bearings & spacing

Line (GAC): D TECHNOLOGY AND DESIGN

Competency: D9 Perform Layout and Fitting Operations

Objectives

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

- Use appropriate tools.
- Use basic techniques for layout and pattern making.
- Use basic techniques for fitting metal, wood or composites components.

LEARNING TASKS	CONTENT
1. Use basic tools and instruments for layout and pattern making	• Measuring tools & instruments • Layout techniques • Straight edges & battens • Scribing • Spiling • Back measuring
2. Perform fitting procedures	• Scribing • Spiling • Back measuring

Achievement Criteria

Performance	The learner will use specialized tools and techniques for basic pattern making, including scribing, spiling and back measuring.
Conditions	The learner will require: • Layout tools. • Materials for demonstrating layout and pattern making.
Criteria	The learner will be evaluated on: • Tool use and technique. • Accuracy of pattern. • Participation in the pattern-making exercise.

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	CONTENT
1. Describe the common types of air compressors and their routine maintenance	• Air as power source • Single & two-stage piston compressors • Rotary vane, diaphragm & screw type compressors • Maintenance procedures • Pressure/volume relationship • Heat/moisture relationship
2. Use compressed air delivery systems	• 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	CONTENT
1. Identify types of spray equipment	• Airless/Air-assist airless • Gravity feed • Siphon feed • Pressure feed • Standard and HVLP systems
2. Describe spray equipment components and operating principles	• Spray equipment components • Air cap selection • Fluid tip selection • Material containers • Hoses and connectors • Spray equipment set up and balancing
3. Use spray equipment to apply single component coatings	• 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: G2 Select Composite Materials

Objectives

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

- Describe FRP core materials.
- Describe appropriate core use and fabrication techniques.

LEARNING TASKS	CONTENT
1. Describe common core materials	• Wood and plywood • Balsa • Plastic foams • Honeycomb • High performance cores
2. Describe the design considerations for using cores	• Physical characteristics • Structural properties • Moisture exposure • Bonding systems • Fabrication techniques
3. Describe the use of common core materials	• Construction • Repair • Location • Load considerations • Density & material type • Thickness & stiffness • Insulation value • Impact resistance • Heat distortion • Moisture absorption

4. Describe the use of syntactic and flotation foams	• Foam types
	  ○ Two-part flotation foams
	  ○ Styrene foams
	  ○ Syntactic foams
	• Mixing & pouring two-part foam
	• Application conditions

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	CONTENT
1. Describe the properties and applications of marine metals	• Steel • Stainless steel • Aluminum • Bronze • Conductive non-metals • Typical applications
2. Describe the compatibility of marine metals	• Galvanic series • Compatibility with non-metallic materials
3. Describe corrosion control methods	• Corrosion assessment • Plating types • Coatings • Sacrificial anodes
4. Select marine metal for application at hand	• Types of metals • Requirement for application • Environmental conditions

Line (GAC): G MATERIALS

Competency: G5 Select Fasteners

Objectives

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

- Describe and select fasteners.

LEARNING TASKS	CONTENT
1. Describe materials used for fasteners	• Bronze • Copper • Stainless • Galvanized • Aluminum • Plastic • Monel
2. Select metal fasteners for common marine applications	• Fastener types • Corrosion considerations • Isolation materials • Sizing fasteners • Appropriate selection • Special fasteners

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	CONTENT
1. Identify and describe commonly used marine adhesive materials and bedding compounds	• Wood glues • Composites adhesives • Bonding metals, glass and thermoplastics • Sealants & bedding compounds • Specialty products
2. Select appropriate materials and follow bonding procedures for adhesives and bedding compounds	• 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	CONTENT
1. Drill and tap holes in metals	• Drills and bits for metals • Sharpening bits • Lubricants and heat control • Drilling techniques for various metals • Tapping procedures
2. Cut and shape metals	• Saws • Files • Grinders • Polishing procedures
3. Cut threads in metal rod	• 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	CONTENT
1. Describe assessment and repair of delaminated core areas by injecting resin	• Causes of delamination • Sounding the extent of delamination • Assessing dry delamination • Drilling and injecting resin into voids
2. Repair cored structures with simple damage to the outer skin and core only	• Damage assessment • Skin removal • Core repair/replacement • Isolating fittings • Re-lamination
3. Repair cored hull structures with damage to both skins and core	• Problems of access • Repairing inside skins
4. Describe the problems associated with teak decking over a cored composite structure	• Teak decks and associated core problems
5. Identify the procedures to repair and rebuild damaged cored deck structure	• 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	CONTENT
1. Assess structural damage as a result of keel impact	• 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
2. Describe the appropriate procedures required to repair/rebuild damaged structures	• Decision to remove keel • Mast removal • Dust control measures • Keel stub repair • Internal grid & secondaries • Plumbing/electrical concerns
3. Describe procedures to remove and re-install lead or iron keels	• 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	CONTENT
1. Describe osmosis blistering in FRP laminates	• Osmosis process • Blister location • Non-osmosis blisters • Hydrolyzed laminates
2. Evaluate laminates for osmosis damage and repair	• Testing procedures • Evaluation of damage • Repair options
3. Identify procedures for repairs of osmosis damaged hulls	• 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: K2 Describe Engine Room Layout and Ventilation

Objectives

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

- Describe principles of engine room layout.
- Describe principles of engine space ventilation.

LEARNING TASKS	CONTENT
1. Describe the relationships between engine components and their optimal layout in the engine room	• Engines • Tanks • Batteries • Exhaust • Access • Weight distribution • Insulation • Fire protection & coatings
2. Describe the function and components of engine room ventilation systems	• Combustion air • Ventilation air • Vapour removal • Vents & ducting sizing • Blowers • Intake considerations

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
1. Describe engine alignment procedures	• Feeler gauges • Pry bars • Shims • Tolerances
2. Describe basic maintenance procedures to propeller shafts, seals and supports	• Repacking glands • Servicing dripless seals • Coupling removal • Keys & keyways • Replacing Cutlass bearings • Strut alignment • Shaft zincs
3. Describe alignment of propeller shafts	• 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
1. Assess and describe the significance of propeller damage or wear	• Mechanical damage • Cavitation damage • Corrosion damage • Balance
2. Remove and replace propellers	• Pullers • Heating • Safety • Nuts, keys & keyways • Tapers and fitting
3. Service propellers	• 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	CONTENT
1. Describe various voltages found in marine use	• 12V, 24V, 32V DC • 110V, 220V AC
2. Perform basic electrical calculations	• Ohm's Law • Practical electrical calculations
3. Use multi-meter to confirm Ohm's Law relationships	• Voltage, resistance & current tests
4. Select appropriate wire size	• 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	CONTENT
1. Identify common symbols used in wiring diagrams and interpret wiring diagrams	• Wiring diagram symbols • Wiring diagrams • Polarity
2. Perform basic wiring procedures to install simple electrical devices	• Parallel & series circuits • Wire connectors & terminals • Heat shrink • Routing and securing cabling
3. Use multi-meter to perform basic electrical tests	• 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	• 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	• Strainers • Filters • Winterizing • Pressure testing • Sacrificial anodes • Pumps and accumulator tanks
3. Describe the procedures for removal and installation of fresh water systems	• 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
1. Identify types of waste water systems	• Black water • Grey water • Bilge water

2. Identify components of waste water systems	• Tank materials
	• Tank location & securing
	• Marine toilets
	• Pumps
	  ○ Sewage
	  ○ Bilge
	• Discharge locations
	• Hoses, valves, deck fittings, vents, anti-siphon loops

3. Describe basic service procedures for waste water systems	• Tanks
	• Pumps
	  ○ Sewage
	  ○ Bilge
	• Marine toilets
	• Hoses, valves, deck fittings, vents, anti-siphon loops

4. Describe the procedures for removal and installation of waste water systems	• Tanks
	• Pumps
	  ○ 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	CONTENT

1. Identify spar components	• Mast
	• Spreaders
	• Boom
	• Hardware
	• Step and deck fittings
	• Other spars
	  ○ Bow sprit
	  ○ Boomkin
	  ○ Sail control

2. Identify standing rigging components	• Types of standing rigging systems, selection to meet working loads • Rigging terminals • Common swaging techniques
3. Describe visual inspection of standing rigging	• Corrosion and fatigue • Typical wear and damage • Dye testing

4. Describe installation and service procedures for roller furling systems	• 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	CONTENT
1. Identify running rigging components	• Sheaves and blocks • Line construction and selection • Line control equipment • Shackles and terminals
2. Describe installation and service procedures for blocks and sheaves	• Associated tackle types and selection • Working loads and selection criteria • Visual inspection for damage
3. Describe installation and service procedures for halyards and other running rigging	• 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	CONTENT
1. Describe the characteristics and appropriate uses of utility coatings	• Primers • Enamels • Clear finishes • Above & below waterline coatings • FRP and wood substrate considerations
2. Describe the commonly used wood preservatives	• Safety considerations • Copper & zinc napthenate • Creosote • Kerosene & linseed oil • Appropriate applications
3. Describe the uses and application of coatings on metals	• Steel • Aluminum • Special considerations for coating metals
4. Select and apply utility coatings by brush and roller	• 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	CONTENT
1. Describe brush and roller techniques to apply high gloss paints by hand	• Preparation techniques for paint • Conventional enamel type paints • Multi-component paints • Brushes • Rollers • Painting techniques
2. Describe brush and roller techniques to apply high gloss varnish to joinery and brightwork	• Preparation techniques for varnish • Varnishes and additives • Brushes for varnish • Varnishing techniques
3. Identify high end coatings	• 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	CONTENT
1. Describe the common configurations of traditional wood vessel structures	• Materials used for backbone structures • The components of backbone structures • Steps in backbone construction
2. Describe the common methods for building wood hull structures	• Materials used for planking • Function of planking • Steps in planking construction • Types of hull planking
3. Describe the common methods for building wood decking and house structures	• Materials selection • Function of the components • Steps in decking and house construction • Covering and sheathing materials
4. Describe cold-molded construction methods	• 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	CONTENT
1. Describe the common fabrication alternatives for producing FRP vessels	• Female molded production boats • Male molded one-off hulls • Future repair considerations
2. Describe the lay-up procedures used in the production manufacturing	• Mold preparation • Gel coating • Material lay-up • Core installation • Thickness zones
3. Describe the fabrication and assembly sequence of small to mid-sized vessels	• Production lay-up • Reinforcing structures • Liners, bulkheads and shelves • Hull/deck assembly • Future repair considerations
4. Describe specialty manufacturing processes for producing composite vessels	• Vacuum bagging • Vacuum assisted infusion • Prepreg materials • Post curing • Future repair considerations

Line (GAC): D TECHNOLOGY AND DESIGN

Competency: D7 Describe Metal Vessel Construction

Objectives

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

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

LEARNING TASKS	CONTENT
1. Describe the common fabrication methods for producing steel and aluminum vessels	• Materials properties and selection • Scantlings • Frame construction • Frameless construction • Chine construction • Rolled plate • CAD design

2. Describe the fabrication and assembly sequence of small to mid-sized vessels	• Lofting
	• Pre-cut materials
	• Framing
	  ○ Transverse frames
	  ○ Longitudinal stringers
	  ○ Strongbacks
	• Plate bending
	• Welding procedures
	• Insulation
	• Interior structures
	• Corrosion considerations
	• Fairing and finishing
	• Coatings

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
1. Describe the procedure to fair the hull lines full size on a loft floor from a scale blueprint and table of offsets	• Reasons for lofting • Tools & equipment • Procedure for lofting • Concept of fairness
2. Describe how to plot full size construction details	• Backbone structure • Plank reduction • Rabbet development
3. Describe how auxiliary views and the true shapes of curved surfaces are developed from the faired lines plan	• Transom • Harpins • Square sections
4. Describe the advancement of lofting techniques using computer programs	• 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	CONTENT
1. Identify stationary power tools	• Safety considerations • Table saws • Band saws • Planer • Jointer • Mitre saw • Drill press • Sanders • Bench grinder
2. Use appropriate stationary power tools	• Tool selection • Safety considerations • Table saws • Band saws • Planer • Jointer • Mitre saw • Drill press • Sanders • Bench grinder
3. Perform basic care of stationary power tools, and change cutters, blades, etc	• 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): H MARINE METALS

Competency: H4 Control Corrosion in Metals

Objectives

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

- Identify corrosion in metals and its causes.
- Apply techniques to control corrosion.

LEARNING TASKS	CONTENT
1. Identify types of corrosion and its causes	• Oxidization • Galvanic corrosion • Exposure to elements • Stray current corrosion • Crevice corrosion

2. Apply techniques to control corrosion from damaging metal structures and components	• Corrosion assessment
	• Coatings
	• Aluminium considerations
	• Galvanic corrosion prevention techniques
	  ○ Anodes
	  ○ Bonding
	  ○ Active corrosion prevention equipment
	• Prevention of stray current corrosion
	  ○ Galvanic isolators
	  ○ Isolation transformers

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: 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	CONTENT
1. Describe repair methods for structural components	• Frames • Planking • Backbone • Decking • Material selection
2. Describe steam bending operations	• Safety considerations • Frame bending • Plank bending • Bending jigs • Compression straps • Timing • Steam boxes • Steam generators
3. Describe repair procedures to damaged backbone structures, longitudinals and deck beams	• Damage assessment • Repair considerations • Fastener removal • Selecting materials, cutting, bending and fitting replacement structures
4. Describe repair procedures to damaged hull planking, decks and house 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	CONTENT
1. Describe the basic design considerations for building plugs and molds	• Part shape & draw angles • Single and multi-component molds • Shop conditions • Plug reinforcing • One-off molds

2. Fabricate a simple plug	• Material selection
	  ○ Plaster
	  ○ Clay
	  ○ FRP
	  ○ Wood
	  ○ Foam
	• Material effect on cure
	• Finishing materials
	• Polishing procedures
	• Release agents
	• Handling and storage

3. Fabricate an FRP mold from the plug fabricated in (2)	• Release agents • Gel coat or paint surfaces • Lay up materials, resins/reinforcements • Lay up sequence • Stiffening alternatives • Curing molds • Mold storage
4. Lay up a structure using the FRP mold fabricated in (3)	• Mold release • Material choices for finish & structure • Lay up sequence • Part curing • Part release & trimming
5. Describe elastomeric tooling and casting techniques	• 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	CONTENT
1. Assess structures for failure	• Inspection techniques • Types of stiffeners • Size & location of stiffeners • Delamination • Ruptured stiffeners
2. Repair and renew secondary bonds of bulkheads, floors, stringers, shelves, engine beds, etc	• Bulkhead attachment • Secondary bonding materials • Failures against hull • Failures on wood surfaces • Use of fasteners
3. Rebuild rotten stringers or engine beds	• Structural & non-structural cores • Mounting fittings • Rules for laminate thickness • Design considerations
4. Rebuild rotten transom stiffeners	• 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	CONTENT
1. Identify procedures to remove the FRP rudders and stabilizers	• Hydraulic cylinders • Tiller assemblies • Quadrants • Autopilot equipment • Bearings and shafts
2. Assess internal damage to rudder assemblies	• Inspections • Stock and tangs • Rudder tubes, gussets & bearings • Laminate damage • Corrosion
3. Remove and replace stock/tang assemblies	• Removal methods • Dimensional stability

4. Rebuild laminate structure and fair rudders	• 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 coredstructures.

LEARNING TASKS	CONTENT
1. Describe the advantages of vacuum bagged FRP construction	• Resin/glass ratios • Choice of materials • Stiffness considerations • Operator cleanliness • Reduced VOCs
2. Identify system components and maintain vacuum delivery system	• Vacuum pumps • Lines, valves, gauges, tanks, regulators, QD couplings, etc. • Resin traps and vacuum transfer equipment
3. Describe procedures for vacuum bagging a non-cored molded composite component	• 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
4. Describe additional requirements of bonding cores and vacuum bagging cored laminates	• Core material selection & configuration • Core preparation • Bonding and installation 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: K3 Remove and Install Engines

Objectives

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

- Assist in removal and installation ofengines.

LEARNING TASKS	CONTENT

1. Plan for engine removal or replacement	• Removal strategy
	  ○ Inboard, outboard and I/O considerations
	• Surface protection
	• Bracing and lifting gear
	• Identification
	  ○ Labelling
	  ○ Photographs

2. Assist in selection, set up and use of engine lifting equipment	• Tackle safety ratings • Cranes • Chain hoists & come-alongs • “A” frames & “C” frames • Dollies
3. Assist in removal and replacement of engines	• Disconnecting engine • Flood/fire prevention • Safety procedures for lifting • Clean up • Re-installation
4. Describe the process for new installations	• 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	CONTENT
1. Describe the properties and applications of common lubricants	• Engine oils & oil selection • Hydraulic oils • Outdrive oils • Break-in oils & additives • Greases
2. Check lubricant fluid levels in engines, transmissions and hydraulic equipment	• Engine oil level • Transmission oil level • Hydraulic oil level • Outdrive oil level
3. Check engine for readiness in advance of starting up	• 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	CONTENT
1. Inspect and service combustion air components	• Air supply ductwork • Air filters & flame arresters
2. Inspect and service cooling system components	• 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
3. Inspect exhaust system components	• Exhaust system testing procedures • Exhaust hoses, mufflers, check valves, thru-hulls
4. Inspect serviceable components of the fuel system	• Fuel tank problems • Fuel lines and shut-off valves • Gasoline and diesel fuel filters • Fuel pump operation • Bleeding fuel systems
5. Service gasoline engine ignition systems	• Inspections • Spark plugs • Ignition components • Bilge blowers
6. Describe servicing procedures to replace engine oil and filters	• 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	• Transmission oils • Servicing procedures • I/O and gear transmission • Transmission fluid coolers
8.	Describe lubrication of moving parts and servicing procedures	• Assessing mechanical components for lubrication • Selecting appropriate oils & greases • Applying oils & greases to mechanical components
9.	Inspect drive belts	• 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
1. Test mechanical engine controls for proper operation	• Mechanical throttle controls • Transmission shifters • Choke, diesel shut off, decompression controls, trolling valves
2. Describe routine adjustment for correct operation of mechanical engine controls	• Mechanical throttle controls • Transmission shifters • Choke, diesel shut off, decompression controls and trolling valves
3. Identify source of engine alarm system failure	• Senders and alarm types • Cooling system overheating. • Exhaust system overheating. • Transmission • Oil pressure • Fuel pressure

4. Identify sources of gauge failure	• Engine gauges
	  ○ 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: K7 Service Steering Gear

Objectives

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

- Describe rudders and steering systems Check lubricant fluid levels.
- Assist in the removal of steering gear and rudders.

LEARNING TASKS	CONTENT
1. Describe the types and function of rudders	• Principles of steering • Types • Sail • Power • Tubes & glands • Bearings & stops

2. Describe steering systems	• Hydraulic
	  ○ Helm pumps
	  ○ Cylinders
	  ○ Power assist
	  ○ Equalizers
	  ○ Piping & valves
	  ○ Lock-out valves
	• Mechanical
	  ○ Tillers
	  ○ Cable & quadrant
	  ○ Pedestal
	  ○ Push-pull systems
	  ○ Rod & gear
	  ○ Power assist
	• Electrical
	  ○ Autopilots
	  ○ Thruster controls
	  ○ Jog controls
	  ○ Remotes

3. Assist in the removal and installation of steering gear and rudders	• Safety considerations • Quadrants • Autopilot equipment and electronics • Bearings, shafts and seals

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: K10 Install and Service Hydraulic Systems

Objectives

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

- Describe the operation and components of hydraulic systems.
- Assist in routine installation, troubleshooting and servicing procedures.

LEARNING TASKS	CONTENT
1. Describe hydraulic system theory	• Pressure • Displacement • Volume & flow

2. Describe the components and function of basic hydraulic systems	• Components of hydraulic systems:
	  ○ Pumps
	  ○ Reservoirs
	  ○ Lines
	  ○ Actuators
	  ○ Valves and controls
	  ○ Hydraulic oils
	  ○ Manifolds

3. Assist in routine installation procedures for hydraulic systems	• Installation procedures for hydraulic pumps:
	  ○ Engine driven pumps
	  ○ Electrically driven pumps
	• Fabrication and installation procedures for lines:
	  ○ Flexible hydraulic lines and terminals
	  ○ Solid hydraulic lines and terminals
	• Hydraulic cylinders
	• Hydraulic motors
	• Reservoirs
	• Oil fill, bleed and start up procedures

4. Assist in routine troubleshooting and servicing procedures for hydraulic systems	• Checking hydraulic systems for leaks, damage and malfunction • Replacing lines, seals and fittings • Bleeding hydraulic systems

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
1. Describe servicing procedures for alternators	• Alternator function • Alternator types • Troubleshooting techniques

2. Describe servicing procedures for starters and starter solenoids	• Starter function
	• Starter types
	  ○ Solenoids
	  ○ Motors
	• Troubleshooting techniques

3. Describe servicing procedures for engine starting circuits	• 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
1. Describe battery capacity, performance and selection for marine applications	• Battery capacities • Battery types • Technological advancements • Chemistry & cycling • Applications and selection considerations
2. Describe hazards associated with batteries	• Lifting & carrying • Hydrogen gas explosions • Acid spills • “Dead” shorts
3. Describe DC power requirements	• Typical loads • Calculating loads • Storage capacity • Charging requirements

4. Assist in the installation of batteries	• Selection and application
	• Installation considerations
	  ○ Location
	  ○ Ventilation
	  ○ Boxes
	  ○ Tie-downs
	• Terminals and cable installation

5. Assist in the installation of charging equipment	• Alternators • Chargers • Switches and relays
6. Describe alternate power sources	• Solar panels • Wind generators • Fuel cells
7. Perform basic battery testing and servicing	• Hydrometer use • Load and capacitance

		• Topping up wet cells • Cleaning terminals
8.	Describe common reasons for battery discharge and failure	• Overcharging • Sulphating • Surface shorting • Corrosion and poor connections
9.	Assist in the selection and installation of DC distribution systems	• 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.

Line (GAC): N INSTALLATIONS

Competency: N1 Install Hardware and Fittings

Objectives

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

- Install marine hardware on topsides and decks.

LEARNING TASKS	CONTENT
1. Describe hardware installed on topsides or decks	• Cleats • Winches • Blocks • Rails and tracks • Stanchions • Windows/hatches • Canvas hardware • Miscellaneous equipment and hardware
2. Install fittings on single skin and cored composite structures	• Material selection • Load size & direction • Options for reinforcing composite structures • Core isolation • Fastener installations in composites • Bedding, backing, sealing and finishing • Windows, hatches and ports
3. Install fittings on wood structures	• Material selection • Load size & direction • Windows, hatches and ports • Options for reinforcing for wood structures • Fastener installations in wood • Bedding, backing, sealing and finishing
4. Install fittings on metal structures	• Material selection • Load size & direction • Windows, hatches and ports • Options for reinforcing metal structures • Inserts • Welded fittings • Fastenings • Compatibility of metals and corrosion control

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: • Tools. • A selection of typical marine hardware. • Marine substrates.
Criteria	The learner will be evaluated on: • 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	CONTENT
1. Identify and select fittings commonly used near or below the waterline	• Surface mount thru-hulls • Flush mount thru-hulls • Transducers & other underwater fittings • Compatibility of metal fittings and fasteners • Safety and valve installation
2. Identify fittings that have deteriorated beyond safe use	• Corrosion or damage to underwater fittings

3. Install surface mount and flush mount thru-hull 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

4. Assist in the installation of miscellaneous underwater fittings and fasteners	• 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	CONTENT
1. Describe basic properties of propane	• Density • Flammability • Odour • Pressure • Safety
2. Describe the installation of propane tanks and supply lines	• Tank and connection locations • Propane tank containment and venting • Piping & distribution lines • Regulators & pressure valves • Solenoids, detectors and alarms • Controls
3. Describe the basic requirements for gas installations	• 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	CONTENT
1. Describe common marine accommodation heating systems	• Diesel, kerosene and solid fuel • Propane • Forced hot air • Hydronic • Cabin heaters
2. Describe the installation and servicing procedures of heating systems	• 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): N INSTALLATIONS

Competency: N7 Install and Service Refrigeration and Air Conditioning Systems

Objectives

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

- Describe typical vessel refrigeration.
- Describe self-contained A/C systems.

LEARNING TASKS	CONTENT
1. Describe marine domestic refrigeration systems	• Principles of refrigeration • Selection considerations • Ice box construction & installation • Electrical systems and requirements • Compressor and component installation • Troubleshooting and service
2. Describe self-contained vessel air conditioning systems	• Selection considerations • Power requirements • Compressor and component installation • Ducting • Controls

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	CONTENT

1. Prepare and prime metal for fairing or finishing	• 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

2. Select fairing materials	• Fairing materials used for steel • Fairing materials used for aluminum • Fairing materials used for lead
3. Describe application of fairing materials	• Application techniques. • Fairing techniques

4. Seal fairing materials and/or prepare for topcoat application	• 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
1. Describe the basic principles of boatyard economics	• 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
2. Describe the key components and legal responsibilities of contracts	• Contract types • Estimates & quotations • Responsibilities of yard & customer • Insurance relationships • Liens and formal dispute resolution
3. Describe the estimating and work order process	• Repair estimates • Operating procedures • Steps in work flow • Record keeping
4. Describe the principles of quality assurance systems	• Objectives of QA • Customer satisfaction • Standards • Procedures • Training • Inspection & quality control • Record keeping • Warranties
5. Describe the agencies that govern the construction of recreational craft and installation of marine equipment	• 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	CONTENT
1. Describe the activities and responsibilities of the marine surveyor	• 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
2. Describe the process and procedures to be followed when vessel damage results in an insurance claim	• 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	CONTENT

1. Describe the elements of a project planning process	• Resources required
	  ○ Labour
	  ○ Materials
	  ○ Shop space/conditions
	• Scheduling

2. Describe project control process	• Basic control mechanisms.
	• Schedule preservation
	  ○ Planned versus actual events
	  ○ Updating timelines
	  ○ Change-order
	  ○ Personnel responsibilities
	  ○ Contingencies
	• Reporting progress/problems

3. Review completed projects and provide feedback	• 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
1. Apply environmental protection practices	• Best Management Practices program • Environmental containment • Record keeping • Training
2. Identify regulatory agencies responsible for enforcing environmental regulations	• 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 repairconsiderations.
- Identify the consequences and repair considerations of enginesubmersion.

LEARNING TASKS	CONTENT
1. Identify types of damage to submerged vessels	• Salt/fresh water • Mechanical • Electrical • Structural • Interior
2. Describe repair considerations to submerged vessels	• Cost/value considerations • Repairers warranty limitations
3. Describe the repair considerations to submerged engines	• 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	CONTENT
1. Identify and describe common thermoplastic materials and their properties	• Acrylic • Polycarbonate • PTFE • Polyethylene • Nylon • Acetal • Bearing materials • Handling & storage of thermoplastics
2. Perform basic machining operations in thermoplastics	• Cutting, drilling and routing
3. Perform bonding and forming procedures for thermoplastic components	• Forming options • Bonding & sealing • Bending limitations
4. Describe the installation of thermoplastic windows	• 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: I3 Perform Fairing and Cosmetic Operations

Objectives

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

- Describe the elements of design and workmanship that contribute to the appearance of wood components.
- Describe procedures for fairing to achieve a high quality finish.

LEARNING TASKS	CONTENT
1. Describe elements of design and use of materials that contribute to the aesthetic qualities of wood components	• Lines and proportions • Concept of fairness • Material selection • Colour & texture • Hardware • Wood plugs • Finishes
2. Describe procedures for fairing to achieve a high quality finish	• Planing curved surfaces • Board sanding • Scraping • Power sanding • Finish sanding • Paint or varnish 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: 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	CONTENT
1. Describe the principles of cold molded construction	• History & development • Design principles • Monocoque construction • Comparison with traditional materials • Adhesives • Sheathing techniques • Vacuum bagging • Appropriate wood types • Planking methods • Framing options • Frameless construction
2. Describe the methods of cold molded construction	• Safety • Mold construction • Materials preparation • Planking lay up • Completion and fairing

3. Describe the repair considerations to cold molded structures	• 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	CONTENT
1. Describe applications and reasons for laminated wood structures	• Beams • Spars • Frames • Keels • Stems • Knees
2. Describe methods for laminating wood components	• Selecting woods • Adhesives • Jig making • Clamping • Cleaning/finishing
3. Describe the vacuum bagging techniques for wood lamination	• Equipment & materials • Jigs • Processes & problems
4. Describe the method of replicating laminated components	• 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: I9 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	CONTENT
1. Sheath a finished wooden component with epoxy resin and fibreglass cloth to produce a clear sealed cosmetic finish	• Surface preparation • Sealing, laminating & curing procedures • Resin & reinforcement choices • UV protection & surface finishes
2. Sheath a wooden structure with polyester resin and a mat/cloth lay-up to reinforce and seal the component	• 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	CONTENT
1. Describe the characteristics of high performance materials and manufacturing techniques	• Carbon, aramid and other fabrics • Epoxy & vinyl resin systems • Vacuum and pre-preg construction • Fabric wet-out systems • Hot bonders
2. Describe repair procedures for damage to high performance structures	• Grinding carbon & aramid fibre • Tool considerations • Variations in taper • Dealing with cores • Materials preparation • Lay-up considerations
3. Describe vacuum and hot bonder techniques for repair work	• 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): L ELECTRICAL

Competency: L4 Install and Service AC Power Supply and Distribution Systems

Objectives

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

- Assist in the installation of AC power sources.
- Assist in the installation of AC distribution systems.

LEARNING TASKS	CONTENT
1. Assist in determining AC power requirements	• AC theory • Calculate typical loads • Panels & distribution systems • Shore power availability • Stray current corrosion
2. Describe hazards associated with AC systems	• Electrocution • Inverter feed • Ground faults
Assist in selecting and installing sources of AC power	• Shore power hook ups • Panel and switching installations • Grounding and safety • Inverters • Genset systems • Genset/shore power interface • Genset installation (electrical only)
Assist in the selection and installation of AC distribution systems	• 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.

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	CONTENT
1. Describe marine electronics	• Theory • Cabling • Ground planes • Electromagnetic Interference (EMI) • Instrumentation • Power supply considerations
2. Assist in the installation and removal of basic marine electronics	• Antennas • Displays • Black boxes • VHF radios • AIS • Radar • Transducers/senders • Heading sensors
3. Describe NMEA data interfacing	• 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 hullstripes.
- Prepare surface.
- Use appropriate protective masking techniques in preparation for sprayfinishing.

LEARNING TASKS	CONTENT
1. Describe procedures for measuring, marking and masking hull stripes	• Waterlines, given bow and stern positions • Boot lines and cove stripes of constant visual width • Curved hull stripes and graphics
2. Describe masking hulls and decks for painting	• 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 preperation for topcoat applications.

LEARNING TASKS	CONTENT

1. Identify materials to prepare surfaces for high- end finishing	• Substrate considerations
	  ○ FRP
	  ○ Metals
	  ○ Plastic
	• Priming materials
	• Fairing materials
	• Sealing materials

2. Describe procedures for preparing surfaces for high-end finishing	• 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	CONTENT
1. Describe multi-component paint systems and their advantages and disadvantages	• Epoxy • Polyurethane • Base/clear • Water borne
2. Describe the application conditions required for spraying topcoat	• Site preparation • Safety considerations • Temperature & moisture levels • Ventilation • Outside work
3. Describe surface preparation	• Cleaning • FRP, Aluminum and Steel surface preparation • Containment • Masking materials
4. Describe the methods of spray application for multi-part paint systems	• 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	CONTENT
1. Describe techniques used to identify various paint types	• Visual inspection • Historical records • Solvent resistance • Adhesion testing
2. Describe repair procedures	• 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	CONTENT

1. Describe lifting systems	• Applications
	• Types
	  ○ Mast & boom
	  ○ Cantilever types
	  ○ Twin stern davits
	• Manual, electric & hydraulic winches

2. Assist in selection and installation of lifting systems	• Load calculations
	• Structural considerations
	• Design considerations
	  ○ Location
	  ○ Stability
	• Installation procedures

3. Assist in servicing lifting systems	• 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

SKILLED TRADES BC

Advanced Workplace Competencies Section 4

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 for details.

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

*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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Industry Subject Matter Experts retained to review the Program Outline (2011):

- Campbell Black — Blackline Marine Inc.
- Nuno Covas — Blackline Marine Inc.
- Ben Gartside — Gartside Marine Engines Ltd.
- Drew Irwin — Philbrook's Boatyard Ltd.
- Brent Jacobi — Blackline Marine Inc.
- Reed Radziszewski — Self-employed
- Dave Richardson — Self-employed
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- Jeff Wilson — Self-employed