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PROGRAM OUTLINE

Marine Service Technician

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MARINE SERVICE TECHNICIAN

PROGRAM OUTLINE

APPROVED

MARCH 2011

Developed by
Industry Training Authority
Province of British Columbia

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Section 1

INTRODUCTION

Marine Service Technician

Foreword

"Marine Service Technician" means a person who performs general servicing and repair operations on recreational vessels and light commercial vessels up to 150 feet in length.

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 encompassing a multitude of activities, and others specializing in only one aspect of the industry.

As such, the trade covers a wide variety of activities and competencies under one trade designation, and no one MST trades worker would be expected to demonstrate all the competencies covered in this Program Outline. Apprentices in the trade must *learn* about the various boatyard activities so that they understand the 'whole boat' and the nature of the boatyard workplace. Certain Core Competencies, 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.

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.

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SAFETY ADVISORY

Be advised that references to the WorkSafeBC 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 steering committee convened by the Transportation Industry Career Development Association. Members include:

- Jeff Adams — Technician — Philbrook's Boatyard Ltd.
- Campbell Black — President — Blackline Marine Inc.
- Peter Dahl — Administrator — West Coast Boatyard Association
- Ben Gartside — CEO — Gartside Marine Engines Ltd.
- Drew Irwin — CEO — Philbrook's Boatyard Ltd.
- Chuck MacKenzie — CEO (Retired) — Cherokee Mechanical Ltd.
- Greg Shorland — Manager — Transportation Career Development Association of BC
- Glenn Spartz — Regional Account Mgr. — Volvo Penta Canada Inc.
- Steve Tyliakos — CEO — Oceanos Marine Solutions Ltd.
- Anthony Utley — CEO — Raven Marine Services Ltd.

Industry subject matter experts retained as outline reviewers:

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

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

How to Use this Document

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
Program Assessment	Communicate program completion requirements and assessment methods	Understand the various assessment requirements for the program	Understand the various assessment requirements for the program	Understand the assessment requirements they would have to fulfill in order to challenge the program
OAC	Communicate the competencies that industry has defined as representing the scope of the occupation	Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification	View the competencies they will achieve as a result of program completion	Understand the competencies they must demonstrate in order to challenge the program
Training Topics and Suggested Time Allocation	Shows proportionate representation of general areas of competency (GACs) at each program level, the suggested proportion of time spent on each GAC, and percentage of time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	Understand the relative weightings of various competencies of the occupation on which assessment is based
Program Content	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measureable achievement criteria for objectives with a practical component	Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels

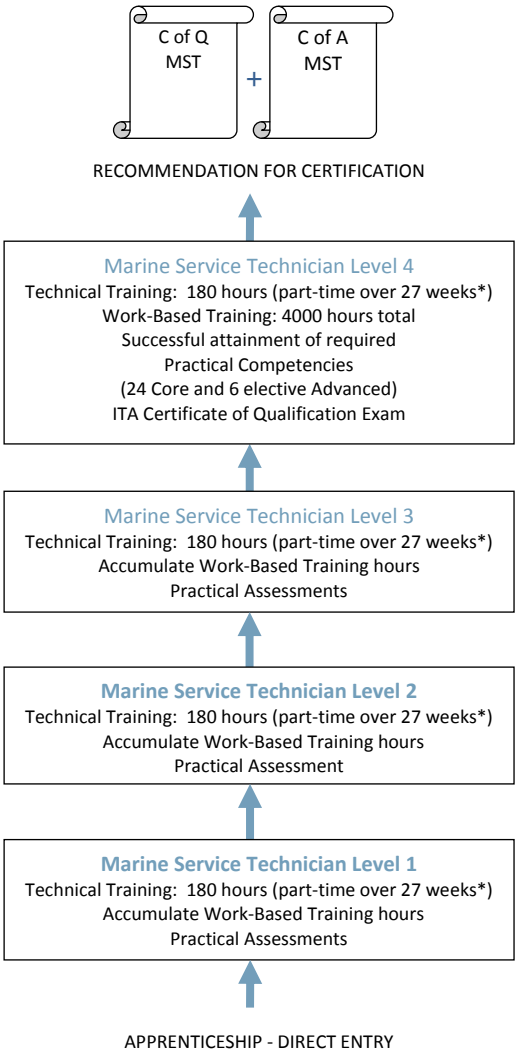
Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
Training Provider Standards	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own	Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors	Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment

Section 2

MARINE SERVICE TECHNICIAN

PROGRAM OVERVIEW

Program Credentialing Model



**Suggested duration based on 5.5 hour week – evening classes + workshops; approximately 108 weeks in total*

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

CROSS-PROGRAM CREDITS
Individuals who hold the credentials below are entitled to receive partial credit toward the completion requirements of this program

- Not applicable

Program Assessment

Apprentices will be assessed fairly and accurately throughout the program on the various skills required to be a professional Marine Service Technician. Assessment activities are designed to provide feedback and allow for further development of skills that have been identified as essential for on the job performance.

Forms of assessment may include:

- In-class individual or group activities
- Assignments to be completed at home or in the workplace
- Development of personal portfolios of evidence documenting performance in the trade
- Theoretical evaluation (such as written tests and quizzes)
- Practical evaluation (real or simulated activities demonstrating the practical performance required in the trade)
- Oral questioning to verify underpinning knowledge and documented evidence of competency

The emphasis in this trade is on workplace skill development: demonstrated knowledge, skill and attributes that make the technician an effective contributor to the success of the employer's enterprise.

Completion Requirement	Evidence of Achievement	Level of Achievement Required
Level 1 Technical Training	Successful completion of on-line moderated studies; written and practical assessments	Minimum 70% on written assessments; declared competent for practical assessments
Level 2 Technical Training	Successful completion of on-line moderated studies; written and practical assessments	Minimum 70% on written assessments; declared competent for practical assessments
Level 3 Technical Training	Successful completion of on-line moderated studies; written and practical assessments	Minimum 70% on written assessments; declared competent for practical assessments
Level 4 Technical Training	Successful completion of on-line moderated studies; written and practical assessments	Minimum 70% on written assessments; declared competent for practical assessments
Work-Based Training Hours	Work-Based training report	As required to attain competencies
Successful attainment of 24 required core competencies plus 6 elective advanced competencies	Submission of logbook signed by the Sponsor	Declared competent
Certificate of Qualification Exam	ITA-administered exam	Minimum 70%
Recommendation for Certification	Approval or sign-off by Sponsor or other individual with sign-off authority	Declared competent

Occupational Analysis Chart

MARINE SERVICE TECHNICIAN

OCCUPATION DESCRIPTION:

THE MARINE SERVICE TECHNICIAN PROVIDES GENERAL REPAIR AND MAINTENANCE SERVICES ON PLEASURE CRAFT AND LIGHT COMMERCIAL VESSELS UP TO 150 FEET IN LENGTH. MARINE SERVICE TECHNICIANS HAVE AN UNDERSTANDING OF COMPOSITE MATERIALS, WOODWORKING AND SYSTEMS INSTALLATIONS, AND HAVE PRACTICAL COMPETENCY IN A RANGE OF SPECIFIC BOATYARD SKILLS. THEY ARE USUALLY EMPLOYED BY MARINAS, BOAT REPAIR YARDS, YACHT MANUFACTURING FACILITIES AND SPECIALTY MARINE SERVICE-PROVIDING BUSINESSES.

SAFETY **A**	Prevent Workplace Injuries A1 **1**	Handle Hazardous Materials Safely A2 1	Use & Maintain Personal Protection Equipment A3 1	Respond to Workplace Emergencies C A4 1	Describe the Role of Worksafe BC A5 1
YARD MANAGEMENT **B**	Describe Boatyard Business Practices B1 4	Maintain Professional Approach B2 1	Describe the Principles of Quality Assurance B3 4	Describe Role of Surveyors & Insurance Adjusters B4 4	Use Communications Tools B5 1
YARD PRACTICES **C**	Describe Environment Protection Practices C1 4	Secure & Block Vessels C C2 1	Describe Principles of Vessel Salvage C3 4	Operate Power and Sail Vessels W C4 0	Operate Straddle Lift Equipment W C5 0
TECHNOLOGY & DESIGN **D**	Define Trade Terminology & Concepts D1 1	Describe Design Basics D2 2	Interpret Technical Drawings D3 1	Describe Principles of Powering D4 2	Describe Wood Vessel Construction D5 3

Control Projects W B6 4	Describe FRP Vessel Construction D6 3

Program Overview

Line	Competency	Designation	Code	1	2	3	4	5
	Describe Metal Vessel Construction		D7			3		
	Perform Lofting Operations	W	D8			3		
TRADE MATHEMATICS E	Perform Basic Math Calculations		E1	1				
	Perform Density, Area & Volume Calculations		E2	1				
	Perform Measurement Operations	C	E3	1				
	Perform Layout and Fitting Operations	C	E4		2			
TOOLS & EQUIPMENT F	Use Common Hand Tools	C	F1	1				
	Use Common Stationary Power Tools	C	F2			3		
	Use Portable Power Tools	C	F3		2			
	Describe Compressed Air Delivery Systems		F4		2			
	Use Spray Gun	C	F5		2			
MATERIALS G	Identify Properties of Common Woods		G1	1				
	Describe & Select Wood Repair Materials		G2		2			
	Describe Thermosetting Resin Types, Additives & Cure Factors		G3	1				
	Identify Reinforcement Types, Styles, Design Considerations		G4	1				
	Identify Thermoplastics & Demonstrate Basic Handling Techniques	C	G5				4	
	Describe Properties & Compatibility of Marine Metals		G6		2			
	Describe & Select Single Component Coatings & Preservatives		G7		2			
	Describe & Select Fasteners		G8		2			
	Select & Use Adhesives & Bedding Compounds	C	G9		2			
	Select & Use Abrasive Materials	C	G10		2			
	Select & Use Caulking Materials for Wood Vessels	W	G11					0
FABRICATION H	Fabricate Plug, Mold, & Composites Part	C	H1			3		
	Fabricate Advanced FRP Tooling	W	H2					0
	Sheath Wood Structure with Composite Materials	C	H3				4	
	Perform Vacuum Bag Laminating	W	H4			3		
	Perform Cold Molding Operations	W	H5				4	
	Perform Wood Lamination Operations	W	H6				4	

	Perform Joinery Operations					
	W					H7
						0

	Install and Repair Teak Decking					
	W					H8
						0

MARINE METALS	Perform Drilling & Cutting Operations in Metals					
I	C					I1
		2				

	Weld Marine Metals					
	W					I2
						0

	Fabricate with Marine Metals					
	W					I3
						0

	Prevent Corrosion in Metals					
	W					I4
			3			

	Apply Fairing and Finishing Materials to Metals					
	W					I5
			3			

WOODWORK REPAIRS	Identify & Describe Rot & Deterioration Damage in Wood					
J	J1					
	1					

	Perform Structural Repairs in Wood					
	W					J2
			3			

	Perform Fairing & Cosmetic Operations in Wood					
	W					J3
				4		

COMPOSITE REPAIRS	Repair Damage to FRP Laminates					
K	W					K1
		2				

	Repair/Rebuild FRP Reinforcing Structures					
	W					K2
			3			

	Repair Composite Sailboat Fin Keel & Supporting Structure					
	W					K3
		2				

	Repair & Replace FRP Rudders					
	W					K4
			3			

	Evaluate & Repair Osmosis Damage					
	W					K5
		2				

	Repair High Performance FRP Structures					
	W					K6
				4		

	Clean & Maintain Gel Coat Surfaces					
	C					K7
	1					

	Repair Gel Coat Damage					
	W					K8
	1					

	Repair Single Skin Structural Damage in Composites					
	C					K9
	1					

MECHANICAL SYSTEMS	Identify Engine Components					
L	L1					
	1					

	Describe Engine Room Layout & Ventilation					
	L2					
		2				

	Remove & Install Engines					
	W					L3
			3			

	Identify & Describe Drive Train Types & Components					
	L4					
	1					

	Perform Engine Pre-Start Inspection					
	C					L5
			3			

	Service Inboard Engine Components					
	W					L6
			3			

Describe Engine Lubrication				
L7				
		3		

Service Mechanical Engine Controls, Alarms & Gauges				
W				L8
		3		

Install & Service Steering Gear				
W				L9
		3		

Service Engine Mounts, Shafting & Alignment				
W				L10
	2			

Service Propellers				
C				L11
	2			

Repair & Adjust Propellers				
W				L12
				0

Program Overview

	Install & Service Hydraulic Systems	W	L13			3		
	Describe Alarms & Detectors		L14				4	
	Describe Submerged Engine Salvage		L15				4	
FINISHING & PAINTING **M**	Apply Coatings by Brush and Roller	C	M1					0
	Select & Apply Anti-fouling Paints	W	M2	1				
	Mark & Mask Waterlines & Stripes	W	M3				4	
	Describe Multi-Component Paint Systems		M4				4	
	Prep & Prime for Multi-Component Topcoats	W	M5					0
	Select & Spray Multi-Component Topcoats	W	M6				4	
	Repair Multi-Component Topcoats	W	M7				4	
	Brush-Apply Gloss Paints & Varnishes	W	M8					0
FASTENINGS & INSTALLATIONS **N**	Install Hardware & Fittings	C	N1			3		
	Install Thru-Hulls & Underwater Equipment	C	N2			3		
ELECTRICAL SYSTEMS **O**	Describe Workplace AC Systems & Maintain Equipment	C	O1	1				
	Identify Relationship of Current, Resistance & Voltage		O2	1				
	Perform Basic Wiring & Testing Procedures	C	O3		2			
	Troubleshoot & Service Starting & Charging Systems	W	O4					0
	Describe Battery Installations		O5			3		
	Install & Service DC Power Supply Systems	W	O6					0
	Install & Service DC Distribution Systems	W	O7					0
	Install & Service Inverters & Onboard AC Systems	W	08					0
	Install Marine Electronics	W	09				4	

Program Overview

RIGGING INSTALLATIONS P	Step, Unstep and Store Masts W P1	Install & Service Rigging W P2	Install & Service Deck Hardware W P3	Splice Lines W P4	Tune Rigging W P5	Assemble Spars W P6
	2	2	0	0	0	0

Service & Repair Carbon Spars W P7
0

MISCELLANEOUS INSTALLATIONS Q	Install & Service Fresh Water Systems W Q1	Install & Service Waste Plumbing & Pumps W Q2	Install & Service Davits & Hoists W Q3	Describe Propane Distribution Systems Q4	Install & Service Heating Systems W Q5	Install & Service Refrigeration & A/C Systems W Q6
	2	2	4	3	3	3

Service & Repair Inflatable Vessels W Q7
0

W = Workplace assessed by employer (elective advanced competency – six to be assessed)

C = Core Practical Assessment through training institution and/or workplace by employer (all apprentices)

SUGGESTED SCHEDULE OF TIME ALLOTMENT

MARINE SERVICE TECHNICIAN – LEVEL 1

		% of Time	Theory	Practical
Line A	**SAFETY**	**18%**		
A1	Prevent Workplace Injuries			✓
A2	Handle Hazardous Materials Safely			✓
A3	Use & Maintain Personal Protection Equipment			✓
A4	Respond to Workplace Emergencies		✓	✓
A5	Describe the Role of WorkSafe BC		✓	
Line B	**YARD MANAGEMENT**	**8%**		
B2	Maintain Professional Approach		✓	
B5	Use Communications Tools		✓	✓
Line C	**YARD PRACTICES**	**4%**		
C2	Secure & Block Vessels		✓	✓
Line D	**TECHNOLOGY & DESIGN**	**8%**		
D1	Define Trade Terminology & Concepts		✓	
D3	Interpret Technical Drawings		✓	✓
Line E	**TRADE MATHEMATICS**	**14%**		
E1	Perform Basic Math Calculations		✓	
E2	Perform Density, Area & Volume Calculations		✓	
E3	Perform Measurement Operations		✓	✓
Line F	**TOOLS & EQUIPMENT**	**5%**		
F1	Use Common Hand Tools		✓	✓

		% of Time	Theory	Practical
Line G	**MATERIALS**	**10%**		
G1	Identify Properties of Common Woods		✓	
G3	Describe Thermosetting Resin Types, Additives & Cure Factors		✓	
G4	Identify Reinforcement Types, Styles, Design Considerations		✓	
Line J	**WOODWORK REPAIRS**	**4%**		
J1	Identify & Describe Rot & Deterioration Damage in Wood		✓	
Line K	**COMPOSITE REPAIRS**	**10%**		
K7	Clean & Maintain Gel Coat Surfaces		✓	✓
K8	Repair Gel Coat Damage		✓	✓
K9	Repair Single Skin Structural Damage in Composites		✓	✓
Line L	**MECHANICAL SYSTEMS**	**7%**		
L1	Identify Engine Components		✓	
L4	Identify & Describe Drive Train Types & Components		✓	
Line M	**FINISHING & PAINTING**	**4%**		
M2	Select & Apply Anti-fouling Paints		✓	✓
Line O	**ELECTRICAL SYSTEMS**	**8%**		
O1	Describe Workplace AC Systems & Maintain Equipment		✓	✓
O2	Identify Relationship of Current, Resistance & Voltage		✓	✓
	Total Percentage for Marine Service Tech Level # 1	**100%**		

MARINE SERVICE TECHNICIAN – LEVEL 2

		% of Time	Theory	Practical
Line D	**TECHNOLOGY & DESIGN**	**6%**		
D2	Describe Design Basics		✓	
D4	Describe Principles of Powering		✓	
Line E	**TRADE MATHEMATICS**	**5%**		
E4	Perform Layout and Fitting Operations		✓	✓
Line F	**TOOLS & EQUIPMENT**	**14%**		
F3	Use Portable Power Tools		✓	
F4	Describe Compressed Air Delivery Systems		✓	
F5	Use Spray Gun		✓	✓
Line G	**MATERIALS**	**26%**		
G2	Describe & Select Wood Repair Materials		✓	
G6	Describe Properties & Compatibility of Marine Metals		✓	
G7	Describe & Select Single Component Coatings and Preservatives		✓	
G8	Describe & Select Fasteners		✓	
G9	Select & Use Adhesives & Bedding Compounds		✓	✓
G10	Select & Use Abrasive Materials		✓	✓
Line I	**MARINE METALS**	**5%**		
I1	Perform Drilling & Cutting Operations in Metals		✓	✓
Line K	**COMPOSITE REPAIRS**	**12%**		
K1	Repair Damage to FRP Laminates		✓	✓
K3	Repair Composite Sailboat Fin Keel & Supporting Structure		✓	✓
K5	Evaluate & Repair Osmosis Damage		✓	✓
Line L	**MECHANICAL SYSTEMS**	**13%**		
L2	Describe Engine Room Layout & Ventilation		✓	
L10	Service Engine Mounts, Shafting & Alignment		✓	✓
L11	Service Propellers		✓	✓
Line O	**ELECTRICAL SYSTEMS**	**5%**		
O3	Perform Basic Wiring & Testing Procedures		✓	✓
Line P	**RIGGING INSTALLATIONS**	**7%**		
P1	Step, Unstep and Store Masts		✓	✓
P2	Install & Service Rigging		✓	✓
Line Q	**MISCELLANEOUS INSTALLATIONS**	**7%**		
Q1	Install & Service Fresh Water Systems		✓	✓
Q2	Install & Service Waste Plumbing & Pumps		✓	✓
	Total Percentage for Marine Service Tech Level # 2	**100%**		

MARINE SERVICE TECHNICIAN – LEVEL 3

		% of Time	Theory	Practical
Line D	**TECHNOLOGY & DESIGN**	**10%**		
D5	Describe Wood Vessel Construction		✓	
D6	Describe FRP Vessel Construction		✓	
D7	Describe Metal Vessel Construction		✓	
D8	Perform Lofting Operations		✓	✓
Line F	**TOOLS & EQUIPMENT**	**5%**		
F2	Use Common Stationary Power Tools		✓	✓
Line H	**FABRICATION**	**10%**		
H1	Fabricate Plug, Mold, & Composites Part		✓	✓
H4	Perform Vacuum Bag Laminating		✓	✓
Line I	**MARINE METALS**	**8%**		
I4	Prevent Corrosion in Metals		✓	✓
I5	Apply Fairing and Finishing Materials to Metals		✓	✓
Line J	**WOODWORK REPAIRS**	**4%**		
J2	Perform Structural Repairs in Wood		✓	✓
Line K	**COMPOSITE REPAIRS**	**8%**		
K2	Repair/Rebuild FRP Reinforcing Structures		✓	✓
K4	Repair & Replace RFP Rudders		✓	✓
Line L	**MECHANICAL SYSTEMS**	**30%**		
L3	Remove & Install Engines		✓	✓
L5	Perform Engine Pre-Start Inspection		✓	✓
L6	Service Inboard Engine Components		✓	✓
L7	Describe Engine Lubrication		✓	
L8	Service Mechanical Engine Controls, Alarms & Gauges		✓	✓
L9	Install & Service Steering Gear		✓	✓
L13	Install & Service Hydraulic Systems		✓	✓
Line N	**FASTENINGS & INSTALLATIONS**	**10%**		
N1	Install Hardware & Fittings		✓	✓
N2	Install Thru-hulls & Underwater Equipment		✓	✓
Line O	**ELECTRICAL SYSTEMS**	**5%**		
O5	Describe battery installations		✓	
Line Q	**MISCELLANEOUS INSTALLATIONS**	**10%**		
Q4	Describe Propane Distribution Systems		✓	
Q5	Install & Service Heating Systems		✓	✓
Q6	Install & Service Refrigeration & A/C Systems		✓	✓
	Total Percentage for Marine Service Tech Level # 3	**100%**		

MARINE SERVICE TECHNICIAN – LEVEL 4

		% of Time	Theory	Practical
Line B	**YARD MANAGEMENT**	**20%**		
B1	Describe Boatyard Business Practices		✓	
B3	Describe the Principles of Quality Assurance		✓	
B4	Describe Role of Surveyors & Insurance Adjusters		✓	
B6	Control Projects		✓	✓
Line C	**YARD PRACTICES**	**8%**		
C1	Describe Environment Protection Practices		✓	
C3	Describe Principles of Vessel Salvage		✓	
Line G	**MATERIALS**	**6%**		
G5	Identify Thermoplastics & Demonstrate Basic Handling Techniques		✓	✓
Line H	**FABRICATION**	**18%**		
H3	Sheath Wood Structure with Composite Materials		✓	✓
H5	Perform Cold Molding Operations		✓	✓
H6	Perform Wood Lamination Operations		✓	✓
Line J	**WOODWORK REPAIRS**	**5%**		
J3	Perform Fairing & Cosmetic Operations in Wood		✓	✓
Line K	**COMPOSITE REPAIRS**	**5%**		
K6	Repair High Performance FRP Structures		✓	✓
Line L	**MECHANICAL SYSTEMS**	**10%**		
L14	Describe Alarms & Detectors		✓	
L15	Describe Submerged Engine Salvage		✓	
Line M	**FINISHING & PAINTING**	**20%**		
M3	Mark & Mask Waterlines & Stripes		✓	✓
M4	Describe Multi-Component Paint Systems		✓	
M6	Select & Spray Multi-Component Topcoats		✓	✓
M7	Repair Multi-Component Topcoats		✓	✓
Line O	**ELECTRICAL SYSTEMS**	**4%**		
O9	Install Marine Electronics		✓	✓
Line Q	**MISCELLANEOUS INSTALLATIONS**	**4%**		
Q3	Install & Service Davits & Hoists		✓	✓
	Total Percentage for Marine Service Tech Level # 4	**100%**		

Section 3

MARINE SERVICE TECHNICIAN

PROGRAM OUTLINE

Marine Service Technician

Level 1

LINE (GAC): A SAFETY

Competency: A1 Prevent Workplace Injuries

Objectives

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

- Practice the safe use of tools and equipment.
- Describe safety procedures to prevent workplace injuries and fire.

LEARNING TASKS	CONTENT
Demonstrate the proper ways to use boatyard tools and equipment to minimize the possibility of personal injury.	• Tool handling • Guards • Lock outs • Compressed air • Lifting equipment • Noise
Describe procedures to prevent falls and strain injuries.	• Ladder & scaffold use • Safety harness, ascending masts • Fall prevention, "traps" • Lifting, confined spaces, fatigue
Describe procedures to prevent electrical shock injuries.	• Electric current theory • Extension cords, grounding, insulation • Water hazard • Overhead cables • Tagging & removing unsafe equipment from service
Describe procedures for working safely around water.	• Hypothermia, drowning • Pfd use • Self-rescue
Describe procedures for working safely in confined spaces and with batteries.	• Confined spaces hazards, flammables, dusts, hot surfaces • Moving machinery • Battery acid & hydrogen gas • Short circuit burns, explosions

Prevent fire hazards.

- Fuels, flashpoints, combustibility
- Vapour & dust explosion
- Sources of ignition
- Spontaneous combustion
- Materials handling & storage

Achievement Criteria

Performance	The learner will work safely on the job.
Conditions	The learner will require: • A work place or training environment
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout the entire task • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements

LINE (GAC): A SAFETY

Competency: A2 Handle Hazardous Materials Safely

Objectives:

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

- Recognize and identify hazardous materials commonly found in the boatyard.
- Handle them safely.

LEARNING TASKS	CONTENT
1. Describe the dangers associated with common hazardous materials.	• Effects of toxins & dusts • Inhalation • Skin absorption • Ingestion
2. Demonstrate appropriate safe handling and storage of hazardous materials.	• Risk identification • Safe handling • Storage & disposal
3. Describe precautions for working with hazardous materials in confined spaces.	• Ventilation & respiration • Fire prevention • Escape routes
4. Describe WHMIS system.	• MSDS & manufacturer's specifications

Achievement Criteria:

Performance: The learner will handle hazardous materials safely and utilize WHMIS standards.

Conditions: The learner will be given:

- Access to WHMIS related documentation
- Access to hazardous materials and packaging found in the typical marine workplace.
- A work place or training environment

Criteria: The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to work place requirements

LINE (GAC): A SAFETY

Competency: A3 Use & Maintain Personal Protection Equipment

Objectives:

To be competent in this area, the individual must be able to describe and demonstrate the use of personal protection equipment.

LEARNING TASKS	CONTENT
1. Describe the use of safety equipment to limit exposure to fumes & dusts.	• Respirator & dust mask use • Respirator fit & maintenance • Respirator fit test
2. Describe the use of eye and hearing protection.	• Safety glasses, goggles & face shields • Welding arc damage • Hearing protection & tests
3. Describe the use of safety equipment to prevent contact with hazardous liquids.	• Gloves • Barrier creams • Coveralls, clothing, hats, etc.
4. Describe the use of safety equipment to prevent physical injury.	• Footwear • Harnesses • Hard hats • Gloves
5. Demonstrate the use of safety equipment in the workplace.	• Breathing protection • Eye and hearing protection • Skin protection • Protection from physical injury

Achievement Criteria:

Performance	The learner will describe the proper use of personal protection equipment and demonstrate use of safety equipment on the job.
Conditions	The learner will require: • Safety equipment required and commonly used in the marine workplace (or may be required to provide, depending on workplace policy) • A work place or training environment
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout the entire task • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements

LINE (GAC): A SAFETY

Competency: A4 Respond to Workplace Emergencies

Objectives:

To be competent in this area, the individual must be able to describe and demonstrate appropriate procedures for response to fire or accidents in the workplace.

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. Demonstrate fire extinguisher use.	• Supervised firefighting demonstration
5. Obtain certification in OFA Level 1.	• Recognized OFA Level 1 training program

Achievement Criteria:

Performance — The learner will describe in proper sequence, the procedures to follow in a boatyard workplace situation if serious fire and/or injury occurs and demonstrate the use of fire extinguishers.

Conditions
- The learner will require:
- A work place or training environment
- Charged fire extinguisher and supervised conditions for extinguishing fire.

Criteria — The learner will be competent once the performance criteria is met:
- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): A SAFETY

Competency: A5 Describe the Role of WorkSafe BC

Objectives:

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

- Describe the role of the Workers' Compensation Board (WorkSafe BC).
- Describe its relationship to the company and individual workers.

LEARNING TASKS	CONTENT
1. Describe the purpose and role of the WorkSafe BC.	• Rights & responsibilities of employers & employees for safe working conditions • Purpose & role of WorkSafe BC • Legal requirements • Scope & coverage • Registration
2. Describe how WorkSafe BC is funded and the relationship between accidents and rates charged to employers.	• Cost structure and employer rates • Relationship of rates to accident claims
3. Describe proper reporting procedures.	• Informing employer of workplace injury • Informing WorkSafe BC of injury
4. Describe the importance and implications of WorkSafe BC workplace inspections.	• Written forms & reports • WorkSafe BC workplace inspections

LINE (GAC): B YARD MANAGEMENT

Competency: B2 Maintain Professional Approach

Objectives:

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

- Describe a professional approach to work.
- Demonstrate fundamentals of a professional approach to work.

LEARNING TASKS	CONTENT
1. Describe the personal attributes associated with professionalism.	• Responsibility • Reliability • Conflict resolution • Appearance • Self awareness • Open and honest communications
2. Describe the importance of clear and timely communications.	• Communications between employees and customers • Difficult people or situations • Privileged information, feedback, courtesy and timeliness • Record keeping and office paperwork
3. Describe the benefits of maintaining a clean and neat work environment.	• Safety • Efficiency • Morale • Professional presentation
4. Describe opportunities for advancement in the profession and the experience or training required.	• Skill development & training • Career paths
5. Describe the fundamentals of professionalism in the workplace.	• Personal attributes • Communications and customer relations • Clean and tidy work environment • Training and learning opportunities

LINE (GAC): B YARD MANAGEMENT

Competency: B5 Use Communication Tools

Objectives:

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

- Use workplace documents and forms to communicate workplace information.
- Use electronic media to communicate and to access workplace information.

LEARNING TASKS	CONTENT

1. Use workplace documents and forms.	• Technical manuals
	• Policy manuals
	• Catalogues and directories
	• Workplace forms
	  o Time and materials sheets
	  o Work orders
	  o QA forms
	  o Estimates
	  o Requisitions

2. Use electronic media.	• Fax equipment
	• Computer email
	• Web based information
	  o OEM data and manuals
	  o Search engines
	• Computer security and privacy

Achievement Criteria:

Performance	The learner will use written documents or forms and electronic equipment to communicate and to access information relevant to the workplace.
Conditions	The learner will require: • A work place or training environment. • Access to computers and fax equipment
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout the entire task • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements

LINE (GAC): C YARD PRACTICES

Competency: C2 Secure & 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. Demonstrate ability to secure vessels properly at docks.	• Types of lines • Uses of lines • Common knots & hitches • Securing vessels
2. Describe common haul-out equipment and its use.	• Travel lifts • Marine ways • Vertical lifts • Trailers & ramps
3. Describe blocking placement for various vessel types and repair situations.	• Displacement power vessels • Planing hulls • Sailing vessels • Beam blocking sailing vessels • Risk of damage or distortion to older wood vessels
4. Obtain Forklift Operator certification.	• Forklift operation (provincial certification)

Achievement Criteria:

Performance — The learner will describe the correct placement of blocking and jack stands for fin keel sailing vessels and planning-hull power vessels over 40', secure vessels at docks and operate forklift equipment.

Conditions — The learner will require:

- Access to vessels over 40' to demonstrate securing operations.
- Access to Forklift Operator training and certification.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): D TECHNOLOGY & DESIGN

Competency: D1 Define Trade Terminology & Concepts

Objectives:

To be competent in this area, the individual must be able to define 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. Demonstrate an understanding of the concepts of aerodynamics and sailing rig design.	• Sailboat balance • Keel types • Rudder types

LINE (GAC): D TECHNOLOGY & DESIGN

Competency: D3 Interpret Technical Drawings

Objectives:

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

- Read and interpret technical drawings and lines plans.
- Draw simple 3-dimensional objects.

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 technical drawings.	• Drawing tools • Drawing views of 3-dimensional objects • Labelling and dimensioning

LINE (GAC): E TRADE MATHEMATICS

Competency: E1 Perform Basic Math Calculations

Objectives:

To be competent in this area, the individual must be able to perform mathematical calculations used in the trade.

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

LINE (GAC): E TRADE MATHEMATICS

Competency: E2 Perform Density, Area & Volume Calculations

Objectives:

To be competent in this area, the individual must be able to perform basic calculations involving density, specific gravity, area, and volume.

LEARNING TASKS	CONTENT
1. Perform basic calculations.	• Definition of terms • Calculations of specific gravity • Calculations involving density
2. Calculate areas.	• Calculate areas of regular figures • Calculate areas of circles & triangles
3. Calculate volumes.	• Calculate volume of solids of: o Rectangular section o Cylindrical section o Triangular section

LINE (GAC): E TRADE MATHEMATICS

Competency: E3 Perform Measurement Operations

Objectives:

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

- Describe the use of common measurement tools used in the marine industry.
- Use the common measurement tools to quantify objects, liquids, pressures and temperatures.

LEARNING TASKS	CONTENT
1. Describe the function and use of trade measurement tools.	• Measurement terminology • Imperial and metric systems • Scales • Micrometers • Callipers • Laser measurement tools • Liquid volume measurement tools • Temperature measurement tools • Pressure measurement tools
2. Use measurement tools.	• Dimensioning objects • Quantifying liquids • Determining temperatures of environment, surfaces and liquids • Determining pressure in gases and liquids

Achievement Criteria:

Performance — The learner will describe the use of common measurement tools found in the marine industry and demonstrate their use.

Conditions — The learner will require:

- Measurement tools necessary to demonstrate their use
- Objects and conditions that can be measured.
- A suitable work space for making measurements.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): F TOOLS & EQUIPMENT

Competency: F1 Use Common Hand Tools

Objectives:

To be competent in this area, the individual must be able to describe, and demonstrate the use and maintenance of basic hand tools commonly found in the marine industry.

LEARNING TASKS	CONTENT
1. Select and use common hand tools.	• Common hand tools • Woodworking tools • Tools for composite materials • Mechanics' tools • Electricians' tools
2. Maintain hand tools.	• Care of hand tools • Cleaning, sharpening & repair • Grinding and honing edge tools

Achievement Criteria:

Performance — The learner will describe, use and maintain the common hand tools found in the boatyard workplace.

Conditions — The learner will require:

- A selection of basic hand tools used in the boatyard industry.
- A work place or training environment.
- Sharpening equipment for edge tools.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): G MATERIALS

Competency: G1 Identify Properties of Common Woods

Objectives:

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

- Describe the basic properties of commonly used woods used for marine applications.
- Identify common wood species.

LEARNING TASKS	CONTENT
1. Describe the basic properties of commonly used wood species.	• How wood grows • Hardwoods& softwoods • Moisture content • Conversion • 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

LINE (GAC): G MATERIALS

Competency: G3 Describe Thermosetting Resin Types, Additives & Cure Factors

Objectives:

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

- Identify and describe common marine resin types.
- Identify and describe their additives, their characteristics, recommended uses and factors affecting cure.

LEARNING TASKS	CONTENT
1. Identify common marine resin types.	• Polyesters, vinylesters, epoxies • Physical properties • Advantage & disadvantages
2. Identify and describe the use of common 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 use of appropriate resins for common marine applications.	• Construction vs. repair requirements • Handling & storage • Technical literature

LINE (GAC): G MATERIALS

Competency: G4 Identify Reinforcement Types, Styles, Design Considerations

Objectives:

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

- Identify and describe common reinforcement fibers, fabric styles and core materials.
- Describe their appropriate uses.

LEARNING TASKS	CONTENT
1. Identify fibres and fabric styles and describe their function in composite structures.	• Glass, Kevlar®, carbon • Fibre, weaves & styles • Characteristics of reinforcement/resin composites • Handling & storage of reinforcements
2. Describe uses of common fibre reinforcements.	• Construction • Repair
3. Identify and describe common core materials.	• Wood and plywood • Balsa • Plastic foams • Honeycomb • High performance cores
4. Describe the design considerations for using cores.	• Physical characteristics • Flexibility • Moisture exposure • Bonding
5. Describe uses of common core materials.	• Construction • Repair • Location • Load considerations • Density & material type • Thickness & stiffness • Insulation value • Impact resistance • Heat distortion • Moisture absorption

6. Describe the use of two-part flotation foams.	• Urethane foams • Styrene foam • Syntactic foam • Mixing & pouring two-part foam • Application conditions

LINE (GAC): J WOODWORK REPAIRS

Competency: J1 Identify & Describe Rot & Deterioration Damage in Wood

Objectives:

To be competent in this area, the individual must be able to identify and describe the deterioration of marine woodwork due to rot, marine organisms and other environmental elements.

LEARNING TASKS	CONTENT
1. Identify and describe rot damage in wood.	• Types of rot • Conditions leading to rot • Rot prevention • Rot removal and extent of repairs
2. Identify and describe damage caused by marine organisms.	• Marine borers • Vulnerable areas & typical damage • Prevention • Damage repair
3. Identify and describe other forms of deterioration in wood.	• Hydrolization • Drying & checking • Abrasion • Weathering • Ice

LINE (GAC): K COMPOSITE REPAIRS

Competency: K7 Clean & Maintain Gel Coat Surfaces

Objectives:

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

- Describe gel coat gloss deterioration.
- To 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 describe common cosmetic problems with gel coat surfaces and demonstrate cleaning and polishing techniques.

Conditions — The learner will require:

- A selection of commonly used cleaners and polishes for gel coat and cleaning/polishing equipment.
- Sample gel coat surfaces.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): K COMPOSITE REPAIRS

Competency: K8 Repair Gel Coat Damage

Objectives:

To be competent in this area, the individual must be able to repair gel coat damage where application of new material will be required.

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. Repair damaged gel coat surfaces.	• Preparation of repair area • Selecting and mixing resin and additives • Application techniques • Sanding and finishing
4. Repair damaged gel coat non-skid surfaces.	• Preparation of repair area • Selecting and mixing resin and additives • Application techniques

Achievement Criteria:

Performance — The learner will:

- Identify and evaluate gel coat damage.
- Perform gel coat repair procedures.

Conditions — The learner will require:

- Tools
- Materials
- A work place

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): K COMPOSITE REPAIRS

Competency: K9 Repair Single Skin Structural Damage in Composites

Objectives:

To be competent in this area, the individual must be able 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. Demonstrate how to 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. Perform laminate repair and re-surface.	• 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 describe the assessment and procedures involved in the complete structural repair of a damaged single skin laminate and perform structural repairs.

Conditions — The learner will require:

- A sample panel of damaged single skin damage for assessment and repair.
- Resin, reinforcement materials and tools required to effect a repair.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L1 Identify Engine Components

Objectives:

To be competent in this area, the individual must be able to identify and describe the function of the external components of inboard engines.

LEARNING TASKS	CONTENT
1. Identify and 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 • Carburetion • 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

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L4 Identify & Describe Drive Train Types & Components

Objectives:

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

- Identify and describe the functions of typical marine drive train types.
- Identify and describe their components.

LEARNING TASKS	CONTENT
1. Describe drive train types and configurations.	• Inboard • Direct drive • V-drive • Saildrives • I/O • Jet drives
2. Identify components of inboard drive train types.	• Transmissions • Shafting • Bearings & couplings • Stuffing boxes and shaft seals • Struts • CV joints • Propeller configurations

LINE (GAC): M FINISHING & PAINTING

Competency: M2 Select & Apply Anti-fouling Paints

Objectives:

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

- Determine compatibility of anti-foul paints, and select 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-foul.	• Surface evaluation • Removing anti-fouling coatings by scraping • Using chemical paint strippers • Sanding • Wet soda & ice blasting
4. Prepare metal surfaces (lead or iron keels) and the apply barrier coatings.	• Cleaning, drying and preparing iron or lead keels for coating • Sand 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-foul

Achievement Criteria:

Performance — The learner will prepare new or previously painted FRP and metal hulls and apply anti-fouling coatings.

Conditions — The learner will require:

- Application tools.
- Anti-fouling coatings.
- Manufacturer's specifications.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): O ELECTRICAL SYSTEMS

Competency: O1 Describe Workplace AC Systems & Maintain 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.
- Perform minor repairs to 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 • 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 describe the components and arrangement of AC distribution systems found in a typical boatyard workplace and perform minor repairs to power supply and extension cords.

Conditions — The learner will require:

- Stock extension cord cable
- Tools for installing terminals.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): O ELECTRICAL SYSTEMS

Competency: O2 Identify Relationship of Current, Resistance & 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.

LEARNING TASKS	CONTENT
1. Perform basic electrical calculations.	• Ohm's Law • Practical electrical calculations
2. Use multi-meter to confirm Ohm's Law relationships.	• Voltage, resistance & current tests
3. Interpret concept of voltage drop and its significance.	• ABYC Standards application • Voltage drop • Wire gauge selections
4. Describe advantages and disadvantages of various voltages found in marine use.	• 12v, 24v, 32v, 110v systems

Marine Service Technician

Level 2

LINE (GAC): D TECHNOLOGY & DESIGN

Competency: D2 Describe Design Basics

Objectives:

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

- Define and describe the basic concepts of hydrostatics, stability, hull form.
- Define and describe methods of comparison.

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 & DESIGN

Competency: D4 Describe Principles of Powering

Objectives:

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

- Describe the principles governing performance of power driven vessels.
- Describe the selection of 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 select 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. Match propeller dimensions to engine power and speed.	• Propeller selection
6. Select shafts and bearings spacing.	• Propeller shaft sizing • Propeller shaft bearings & spacing

LINE (GAC): E TRADE MATHEMATICS

Competency: E4 Perform Layout and Fitting Operations

Objectives:

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

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

LEARNING TASKS	CONTENT
1. Describe basic tools and instruments for layout and pattern making.	• Measuring tools & instruments • Layout techniques • Straight edges & battens • Scribing • Spiling • Back measuring
2. Perform procedures for fitting.	• 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.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): F TOOLS & EQUIPMENT

Competency: F3 Use Portable Power Tools

Objectives:

To be competent in this area, the individual must be able to use and maintain common portable power tools.

LEARNING TASKS	CONTENT
1. 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
2. Maintain portable power tools.	• Maintenance and cleaning of portable power tools • Selection of blades & cutters • Change bits, cutters, blades • Electrical safety and maintenance • Compressed air delivery requirements

Achievement Criteria:

Performance — The learner will demonstrate the use and maintenance of the commonly used portable power tools found in boatyard workplaces.

Conditions — The learner will require:

- A selection of commonly used portable power tools.
- Materials with which to demonstrate tool use.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): F TOOLS & EQUIPMENT

Competency: F4 Describe Compressed Air Delivery Systems

Objectives:

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

- Describe the basics of air compressors.
- Describe the use and maintenance of 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. Describe the basics of compressed air delivery systems and their maintenance.	• Safety around compressed air • Terminology & materials • Dryers, filters, regulators & fittings • Pipe sizing, pressure drop & air lines

LINE (GAC): F TOOLS & EQUIPMENT

Competency: F5 Use Spray Gun

Objectives:

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

- Describe the operating principles of siphon/gravity feed spray equipment.
- Use a spray gun for simple coating applications.

LEARNING TASKS	CONTENT
1. Describe siphon/gravity feed gun components and operating principles.	• Spray gun components • Air cap selection • Fluid tip selection • Material containers • Hoses and connectors • Gun set up and balancing
2. Use a siphon/gravity feed spray gun to apply single component coatings.	• Gun handling • Troubleshooting • Equipment clean up procedures

Achievement Criteria:

Performance — The learner will describe the components and operating principles of siphon and gravity feed spray equipment and apply single component coatings.

Conditions — The learner will require:

- Siphon/gravity feed spray equipment.
- Materials to demonstrate set up and use of spray equipment.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): G MATERIALS

Competency: G2 Describe & Select Wood Repair Materials

Objectives:

To be competent in this area, the individual must be able to describe and select the appropriate wood materials for structural repair situations.

LEARNING TASKS	CONTENT
1. Describe suitable wood species for the repairs of structural components.	• Physical properties • Durability • Availability • Grain orientation • Moisture content
2. Describe the methods of grading, quantity estimating and pricing of woods.	• Board measure • Moisture meters • Cutting & grading • Plywood size & grades • Estimating quantities required • Pricing

LINE (GAC): G MATERIALS

Competency: G6 Describe Properties & Compatibility of Marine Metals

Objectives:

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

- Describe the properties of commonly used marine metals.
- Describe how they are used.
- Describe corrosion prevention.

LEARNING TASKS	CONTENT
1. Describe the properties of marine metals.	• Steel • Stainless steel • Aluminum • Bronze • Platings • Compatibility with non-metallic materials
2. Describe the compatibility of marine metals.	• Galvanic series • Compatibility of metals with other metals • Corrosion assessment • Corrosion control

LINE (GAC): G MATERIALS

Competency: G7 Describe & Select Single Component Coatings & Preservatives

Objectives:

To be competent in this area, the individual must be able to describe the range of available single component coatings, primers, paints, varnishes and wood preservatives.

LEARNING TASKS	CONTENT
1. Describe the characteristics and appropriate uses of single component paint and varnish systems.	• Primers • Enamels • Varnishes & clear finishes • Above & below waterline coatings • Traditional vs. laminated wood construction
2. Describe the uses and application of coatings on metals.	• Steel • Aluminum • Special considerations for coating metals
3. Describe the commonly used wood preservatives.	• Copper & zinc napthenate • Creosote • Kerosene & linseed oil • Safety • Appropriate applications

LINE (GAC): G MATERIALS

Competency: G8 Describe and Select Fasteners

Objectives:

To be competent in this area, the individual must be able to describe and select common types of fasteners used for marine applications.

LEARNING TASKS	CONTENT
1. Identify and describe materials used for fasteners.	• Bronze • Copper • Stainless • Galvanized • Aluminum • Plastic
2. Identify and select metal fasteners for common marine applications.	• Fastener types • Corrosion considerations • Sizing fasteners • Appropriate selection • Special fasteners

LINE (GAC): G MATERIALS

Competency: G9 Select & Use Adhesives & 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 • Application • 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.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): G MATERIALS

Competency: G10 Select & Use Abrasive Materials

Objectives:

To be competent in this area, the individual must be able to select and use abrasives and associated tools for common marine applications.

LEARNING TASKS	CONTENT
1. Describe the composition and appropriate uses of common 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. Select and use abrasive materials and tools for various 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 common marine applications with wood, metal or composite materials.

Conditions — The learner will require:

- A selection of abrasives.
- A selection of abrasive tools.
- Materials for demonstrating their use.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): I MARINE METALS

Competency: I1 Perform Drilling & Cutting Operations in 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 in steel • Drilling in stainless steel • Drilling in bronze • Drilling in aluminum • 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 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.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): K COMPOSITE REPAIRS

Competency: K1 Repair Damage to FRP Laminates

Objectives:

To be competent in this area, the individual must be able to repair structural damage to FRP hull and 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 single skin hull or deck structures and cored 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. Excavate damaged cores and re-build deck structure.	• Removing teak decking • Cutting open water damaged decks and excavating core materials • Preparing and installing new core • Re-lamination

Achievement Criteria:

Performance — The learner will repair structural damage to single skin and cored FRP hull and deck structures.

Conditions — The learner will require:

- Tools.
- FRP Materials.
- A work place.
- Damaged FRP components.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): K COMPOSITE REPAIRS

Competency: K3 Repair Composite Sailboat Fin Keel & Supporting Structure

Objectives:

To be competent in this area, the individual must be able to assess and repair major structural damage associated with fin keel impacts.

LEARNING TASKS	CONTENT
1. Assess structural damage to fin-keeled sailboat hull as a result of keel impact.	• Types of keel damage • Keel/hull joints • Stiffening grid • Secondary bonding • Attached furnishings • Bulkheads • Rigging
2. Describe the appropriate procedures required to repair/rebuild damaged structures.	• Decision to remove keel • Mast removal • 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 compounds • Inspection of bolts • The keel/hull seam • Repainting

Achievement Criteria:

Performance — The learner will assess and perform all necessary repair procedures related to major structural damage caused by fin keel impact.

Conditions — The learner will require:

- Tools.
- FRP materials.
- A work place.
- Vessels with damaged fin keels.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): K COMPOSITE REPAIRS

Competency: K5 Evaluate & Repair Osmosis Damage

Objectives:

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

- Evaluate osmosis damage.
- Plan and carry out appropriate repair procedures.

LEARNING TASKS	CONTENT
1. Describe osmosis blistering in FRP laminates.	• Osmosis process • Blister location • Non-osmosis blisters • Hydrolyzed laminates
2. Test and evaluate laminates for osmosis damage and repair.	• Testing procedures • Evaluation of damage • Repair options
3. Perform preparation procedures for repairs of osmosis damaged hulls.	• Shop conditions • Repair sequence • Planning
4. Perform complete osmosis repairs.	• Gel coat removal • Drying • Re-lamination • Fairing • Sealing

Achievement Criteria:

Performance — The learner will describe the process of osmosis and resulting damage to composite structures, and perform the procedures necessary to achieve an effective repair.

Conditions — The learner will require:

- Tools.
- FRP materials.
- A work place.
- Vessels with osmosis damage.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L2 Describe Engine Room Layout & 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 • Painting engine components
2. Describe the function and components of engine room ventilation systems.	• Combustion air • Ventilation air • Vapour removal • Vents & ducting sizing • Blowers

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L10 Service Engine Mounts, Shafting & Alignment

Objectives:

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

- Service stuffing boxes, seals and shaft bearings.
- Align inboard engines to drive train.

LEARNING TASKS	CONTENT
1. Describe engine alignment procedures.	• Feeler gauges • Pry bars • Shims • Alignment procedures • Tolerances
2. Describe basic maintenance procedures to propeller shafts and supports.	• Repacking glands • Servicing dripless seals • Coupling removal • Keys & keyways • Replacing Cutless bearings • Strut alignment • Shaft zincs
3. Alignment of propeller shafts.	• Shaft log • Struts & v-struts • Wire alignment method • Laser alignment method

Achievement Criteria:

Performance — The learner will perform procedures for aligning engine to drive train, stuffing box repacking, replacing bearings and aligning shafts.

Conditions — The learner will require:

- Tools.
- Vessels with inboard drive trains.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L11 Service Propellers

Objectives:

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

- Assess propeller damage.
- Remove and replace propellers.

LEARNING TASKS	CONTENT
1. Assess and describe the significance of propeller damage or wear.	• Mechanical damage • Cavitation damage • Corrosion damage
2. Describe procedures to remove and replace propellers.	• Pullers • Heating • Safety • Nuts, keys & keyways • Tapers and fitting

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.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): O ELECTRICAL SYSTEMS

Competency: O3 Perform Basic Wiring & Testing Procedures

Objectives:

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

- Interpret basic 12V DC wiring diagrams.
- Install common electrical components.
- 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 12V electrical appliances.	• Wire size and type selection • Parallel & series systems • Wire connectors & terminals • Routing and securing wires • Common 12V DC appliances • ABYC standards
3. Use multi-meter to perform basic electrical tests.	• Voltage testing • Amperage testing • Continuity testing

Achievement Criteria:

Performance — The learner will interpret basic 12V DC wiring diagrams, install common electrical components found on pleasure vessels and use a multi-meter to perform basic tests.

Conditions — The learner will require:

- ABYC standards or internet access to the standards.
- Electrical wire, devices.
- Tools necessary to demonstrate basic wiring techniques.
- Electrical test equipment.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): P RIGGING INSTALLATIONS

Competency: P1 Step, Un-step and Store Masts

Objectives:

To be competent in this area, the individual must be able to undertake the safe removal, storage and stepping of sailboat masts.

LEARNING TASKS	CONTENT
1. Perform procedures for un-stepping masts.	• Mast wedging and boots • Disconnecting running rigging • Disconnecting electrical connections • Keel stepped masts • Deck stepped masts • Disconnecting standing rigging • Use of cranes & operator signalling • Use of bosun's chair
2. Perform procedures for storing masts and rigging.	• Securing rigging • Protecting electronic senders & antennas • Moving large masts • Storing masts
3. Perform procedures for stepping masts.	• Stepping masts • Deck stepped • Keel stepped • Standing & running rigging setup • Electrical hookups and testing

Achievement Criteria:

Performance — The learner will undertake all procedures for unstopping, storing and stepping sailboat masts under a variety of conditions.

Conditions — The learner will require:

- A work place.
- Sailing vessels with masts to unstep and step.
- Access to crane, lifting equipment.
- Crew for assistance.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): P RIGGING INSTALLATIONS

Competency: P2 Install & Service Rigging

Objectives:

To be competent in this area, the individual must be able to inspect and install components of spars, running and standing rigging.

LEARNING TASKS	CONTENT
1. Install and service blocks and sheaves used for running rigging.	• Block, sheave, associated tackle types and selection • Calculating working loads inspecting blocks & sheaves for wear or damage • Servicing blocks & sheaves • Selecting & installing blocks on masts & booms
2. Install halyards and other running rigging.	• Selection of running rigging lines and wire • Visually inspecting & assessing running rigging for wear & damage • Measuring for running rigging installations • Installing running rigging
3. Inspect and install standing rigging.	• Types of standing rigging systems and selection to meet working loads • Visually inspecting & assessing standing rigging for wear or damage • Making up standing rigging using common swaging techniques • Installing mechanical terminals (Norseman®, Stalok®) • Attachment of rigging equipment to spars
4. Install and service roller furling systems.	• Inspecting for damage, wear or corrosion • Assembling and installing forestay roller furling systems • Assembling and installing mainsail furling systems • Servicing furling systems

Achievement Criteria:

Performance — The learner will perform all procedures related to inspecting and installing components of spars, running and standing rigging, and furling systems.

Conditions — The learner will require:

- Tools.
- Swaging equipment.
- A work place.
- Sailing vessel rigs.
- Rigging components.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): Q MISCELLANEOUS INSTALLATIONS

Competency: Q1 Install & Service Fresh Water Systems

Objectives:

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

- Install and service water tanks.
- Install and service pressure fresh water plumbing equipment.

LEARNING TASKS	CONTENT
1. Select, install and service fresh water tanks.	• Tank materials • Tank location & securing • Selecting fresh water tanks • Installing water tanks • Installing fittings & gauges
2. Select, install and service fresh water pumps, hot water heaters, and associated plumbing.	• Gravity systems • Pressure systems • Hot water systems • Pumps/filters/valves • Accumulator tanks • Piping selection • Drains • ABYC standards

Achievement Criteria:

Performance — The learner will select, install and service water tanks, water heaters and pressure fresh water plumbing equipment.

Conditions — The learner will require:

- A work place.
- Plumbing tools.
- Vessels with fresh water plumbing systems.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): Q MISCELLANEOUS INSTALLATIONS

Competency: Q2 Install & Service Waste Plumbing & Pumps

Objectives:

To be competent in this area, the individual must be able to install and service black water and grey water plumbing, and bilge pumps.

LEARNING TASKS	CONTENT
1. Perform procedures for selecting, installing and servicing marine toilets, sewage holding tanks and associated plumbing.	• Regulations • Tank materials & location • Marine toilets • Macerators • Sewage pumps • Hoses, valves, deck fittings, vents • Anti-siphon loops • ABYC standards
2. Perform procedures for selecting, installing and servicing manual and electrically operated bilge pumps and associated plumbing.	• Manual & powered pumps • Bilge pump selection & capacity • Discharge location • Anti-siphon loops • Inspecting & servicing • ABYC standards
3. Perform procedures for selecting, installing and servicing grey water tanks and associated plumbing.	• Grey water tanks • Location of tanks • Pump selection & capacity • Discharge locations • Anti-siphon loops • Inspecting & servicing • ABYC standards

Achievement Criteria:

Performance The learner will select components and install black water systems, grey water systems and bilge pumps.

Conditions The learner will require:

- A work place.
- Plumbing tools.
- Vessels with waste water plumbing systems.
- Vessels with bilge pumps.

Criteria

The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

Marine Service Technician

Level 3

LINE (GAC): D TECHNOLOGY & 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 the building of 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
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 & 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 • Repair significance of one-off construction
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 • Lines, bulkheads, shelves • Hull/deck assembly • Repair problems
4. Describe specialty manufacturing processes for producing composite vessels.	• Vacuum bagging • Vacuum assisted infusion • Prepreg materials • Post curing • Repair considerations

LINE (GAC): D TECHNOLOGY & 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 alternatives 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
	• Framing
	  o Transverse frames
	  o Longitudinal stringers
	  o Strongbacks
	• Plate bending
	• Welding procedures
	• Interior structures
	• Fairing and finishing
	• Insulation
	• Coatings

LINE (GAC): D TECHNOLOGY & DESIGN

Competency: D8 Perform Lofting Operations

Objectives:

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

- Lay out and fair hull lines full size.
- Develop patterns for principle structural members.

LEARNING TASKS	CONTENT
1. Develop and 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. Develop auxiliary views and the true shapes of curved surfaces from the faired lines plan.	• Transom • Harpins • Square sections
3. Plot full size construction details.	• Backbone structure • Plank reduction • Rabbet development

Achievement Criteria:

Performance — The learner will lay out and fair hull lines full size and develop patterns for principle structural members.

Conditions — The learner will require:

- Vessel lines plans.
- Lofting and measuring tools.
- A work place adequate for lofting operations.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): F TOOLS & EQUIPMENT

Competency: F2 Use Common 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. Select and use appropriate stationary power tools.	• Safety considerations • Table saws • Band saws • Planer • Jointer • Mitre saw • Drill press • Sanders • Bench grinder
2. Care for and maintain stationary power tools, and change cutters, blades, etc.	• Routine maintenance • Dust control • Blade selection • Blade changing • Adjustments

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:

- Tools.
- Access to stationary power tools commonly found in the boatyard workplace.
- Stock materials to demonstrate tool operation.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): H FABRICATION

Competency: H1 Fabricate Plug, Mold, & Composites Part

Objectives:

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

- Fabricate a simple plug.
- Make a mold from the plug.
- Produce a composites part from the mold.

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
2. Select appropriate materials and fabricate a simple plug.	• Plaster, clay, FRP, wood, foam • Material effect on cure • Finishing materials • Polishing procedures • Release agents • Plug reinforcing, handling & storage
3. Select appropriate materials and fabricate a mold from the plug fabricated in (2).	• Gel coat or paint surfaces • Lay up materials, resins/reinforcements • Layup sequence • Stiffening alternatives • Curing molds • Mold storage
4. Select appropriate materials and lay up a structure using the mold fabricated in (3).	• Mold release • Material choices for finish & structure • Layup sequence • Part release • Part curing & 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. • A work place or training environment.
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout the entire task • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements

LINE (GAC): H FABRICATION

Competency: H4 Perform Vacuum Bag Laminating

Objectives:

To be competent in this area, the individual must be able to laminate single skin and cored structures using various vacuum bag techniques.

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. Describe vacuum pump types, the basic components of a vacuum delivery system and their routine maintenance.	• Vacuum pumps • Lines, valves, gauges • Regulators, QD couplings • Resin traps
3. Describe procedures for vacuum bagging a non-cored molded composite part.	• Fabricating processes, wet/dry bagging, infusion • Bag material • Sealant, bleeder & breather materials • Peel plies • Choice of reinforcement
4. Fabricate cored composite structures or wood structures using vacuum bag techniques.	• Core materials & preparation • Laminated wood structures • Bonding putties, glues & resins • Fabrication techniques

Achievement Criteria:

Performance — The learner will use vacuum bag techniques to laminate single skin and cored structures or laminated wood components.

Conditions — The learner will require:

- Molds for vacuum bagged components.
- Vacuum bagging equipment.
- Composites layup tools.
- Composites resins, reinforcements and core materials.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

Line (GAC): I MARINE METALS

Competency: I4 Prevent Corrosion in Metals

Objectives:

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

- Identify corrosion in metals and its causes.
- Use techniques to prevent corrosion.

LEARNING TASKS	CONTENT
1. Identify and describe galvanic corrosion and its causes.	• Galvanic series • Compatibility of metals • Exposure to elements • Dissimilar metals and corrosion • Stray current corrosion • Corrosion assessment

2. Prevent or minimize corrosion from damaging metal structures and components.	• Coatings
	• Galvanic corrosion prevention techniques
	  o Anodes
	  o Bonding
	  o Active corrosion prevention equipment
	• Prevention of stray current corrosion

Achievement Criteria:

Performance: The learner will identify causes of corrosion in marine metals and use techniques to prevent or minimize corrosion.

Conditions: The learner will require:

- Tools.
- Vessels.
- Zincs.
- Wire and terminals.
- Electrical test equipment.

Criteria: The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): I MARINE METALS

Competency: I5 Apply Fairing and Finishing Materials to Metals

Objectives:

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

- Prepare and prime metal surfaces for fairing application.
- Fair metal vessel surfaces.

LEARNING TASKS	CONTENT
1. Prepare and prime metal for above and below waterline fairing.	• Metal preparation for priming and fairing operations above and below waterline o Steel o Aluminum o Lead • Primers for steel • Primers for aluminum • Primers for lead • Application techniques
2. Select and apply fairing materials.	• Fairing materials used for steel. • Fairing materials used for aluminum. • Fairing materials used for lead. • Application techniques.
3. Seal fairing materials and/or prepare for topcoat application.	• Preparation of faired surfaces before coating o Steel o Aluminum o Lead • Final preparation for topcoating

Achievement Criteria:

Performance — The learner will fair and finish metal vessel surfaces to provide a fair and protected surface ready for final topcoat painting.

Conditions — The learner will require:

- Fairing tools.
- Abrasives.
- Compressor and spray equipment.
- Primer coatings.
- Metal vessels.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): J WOODWORK REPAIRS

Competency: J2 Perform Structural Repairs in Wood

Objectives:

To be competent in this area, the individual must be able to perform procedures to repair or replace structural members and planking in traditional wood vessels.

LEARNING TASKS	CONTENT
1. Describe the process of steam bending and the use of steam bending equipment.	• Material selection • Steam boxes • Steam generators • Frame laminating
2. Perform steam bending operations.	• Frame bending • Plank bending • Bending jigs • Compression straps • Timing • Pre-treatment of wood
3. Perform repairs to damaged backbone structures, longitudinals and deck beams.	• Damage assessment • Repair options • Fastener removal • Selecting materials, cutting, bending and fitting replacement structures
4. Perform repairs to damaged hull planking, decks and house structures.	• Damage assessment • Repair options • Selecting materials, cutting, bending and fitting replacement structures

Achievement Criteria:

Performance — The learner will repair/replace damaged structures in traditional wood vessels using common woodworking techniques and steam bending.

Conditions — The learner will require:

- Woodworking tools.
- Wood stock materials.
- Wood vessels.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): K COMPOSITE REPAIRS

Competency: K2 Repair/Rebuild FRP Reinforcing 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.	• Types of stiffeners • Size & location of stiffeners • Delamination • Ruptured stiffeners
2. Repair and renew secondary bonds at bulkheads, shelves, 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
4. Rebuild rotten transom stiffeners.	• Assessing rot damage in transom core • Determining repair options • Removing rotted materials • Removing transoms • Fittings & I/O cut-outs • Re-lamination • Refinishing

Achievement Criteria:

Performance — The learner will repair, renew and rebuild damaged, failed or rotted structural members and stiffeners in FRP vessels.

Conditions — The learner will require:

- Tools.
- Composites resins and reinforcement materials.
- FRP vessels.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): K COMPOSITE REPAIRS

Competency: K4 Repair & Replace FRP Rudders

Objectives:

To be competent in this area, the individual must be able to remove, repair/rebuild, and replace damaged sailboat rudders.

LEARNING TASKS	CONTENT
1. Remove FRP rudders from sailboats.	• Hydraulic cylinders • Tiller assemblies • Quadrants • Autopilot equipment
2. Assess internal damage to rudder assemblies.	• Stock and tangs • Rudder tubes, gussets & bearings
3. Remove and replace stock/tang assemblies.	• Removal options • Maintaining dimensional stability • Relamination techniques
4. Fair rudders to templates or to symmetrical foil shapes.	• Creating templates • Fairing to templates

Achievement Criteria:

Performance — The learner will remove FRP sailboat rudders, replace stock/tang assemblies and rebuild/fair to original shape.

Conditions — The learner will require:

- Tools.
- Template materials.
- Composites resins and reinforcement materials.
- FRP sailboat rudders.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L3 Remove & Install Engines

Objectives:

To be competent in this area, the individual must be able to remove and install new or repaired inboard and I/O engines.

LEARNING TASKS	CONTENT
1. Plan for engine removal or replacement.	• Routing • Joinery protection • Bracing
2. Select, set up and use engine lifting equipment.	• Tackle safety ratings • Cranes • Chain hoists & come-alongs • “A” frames & “C” frames • Dollies
3. Perform procedures for removal and replacement of engines.	• Disconnecting engine • Flood/fire prevention • Safety procedures for lifting • Clean up • Re-installation
4. Describe I/O installations.	• I/O drive installation • Exhaust, transmission, steering equipment

Achievement Criteria:

Performance — The learner will plan and perform the safe and efficient removal and re-installation of inboard and I/O engines.

Conditions — The learner will require:

- Tools.
- Heavy lifting equipment.
- Vessels with inboard engines.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L5 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 • Other oils/lubricating fluids • 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 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 describe lubricants used in marine engines and transmissions, their properties and applications, and inspect engines for readiness to start up.

Conditions — The learner will require:

- Tools.
- Access to marine engines.
- Lubricants.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L6 Service inboard Engine Components

Objectives:

To be competent in this area, the individual must be able to perform routine servicing procedures on inboard engine systems.

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
3. Inspect exhaust system components.	• Exhaust system testing procedures • Exhaust hoses, mufflers, check valves, thru-hulls
4. Inspect and service fuel lines and components.	• Fuel tank problems • Repairing or replacing lines, shut-off valves
5. Inspect and service external gasoline fuel system components.	• Fuel pump operation • Gasoline filters
6. Inspect and service external diesel fuel system components.	• Fuel pump operation • Diesel fuel filters • Bleeding diesel fuel systems
7. Inspect and service gasoline engine ignition systems.	• Spark plugs • Ignition components.
8. Check lubricant fluid levels and perform service and replacement operations.	• Lubricant fluid levels • Oil and filter change • Transmission oil change

Achievement Criteria:

Performance — The learner will inspect inboard engine systems and perform routine servicing and repair operations.

Conditions — The learner will require:

- Tools.
- Engine manuals or online access.
- Replacement parts.
- Marine engines.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L7 Describe Engine Lubrication

Objectives:

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

- Describe engine and transmission oil servicing.
- Describe lubrication of mechanical components.

LEARNING TASKS	CONTENT
1. Describe when and why engine oil and filters are changed.	• Lubrication servicing schedules • Warranty implications • Oil contamination • Oil analysis
2. Describe procedures to replace engine oil and filters.	• Oil removal techniques • Oil disposal • Filter removal & replacement
3. Describe transmission fluid and filter service.	• Transmission oils • Servicing procedures
4. Describe lubrication of moving parts and servicing procedures.	• Assessing mechanical components for lubrication • Selecting appropriate oils & greases • Applying oils & greases to mechanical components

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L8 Service Mechanical Engine Controls, Alarms & Gauges

Objectives:

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

- Test and perform adjustment operations on mechanical engine controls.
- Troubleshoot and repair engine alarms and gauges.

LEARNING TASKS	CONTENT
1. Check mechanical engine controls for proper operation.	• Checking mechanical throttle controls • Checking transmission shifters • Checking choke, diesel shut off, decompression controls, trolling valves
2. Perform routine adjustment for correct operation of mechanical engine controls.	• Adjusting mechanical throttle controls • Adjusting transmission shifters • Adjusting choke, diesel shut off, decompression controls, etc. • Adjusting trolling valves
3. Troubleshoot and repair engine alarms.	• Senders and alarm types • Cooling system overheating. • Exhaust system overheating. • Transmission • Oil pressure • Fuel pressure
4. Troubleshoot and repair engine gauges.	• Tachometers • Temperature • Oil pressure • Fuel system and tank levels

Achievement Criteria:

Performance — The learner will perform adjustment procedures for inboard engine mechanical controls and troubleshoot engine alarms and gauges.

Conditions — The learner will require:

- Tools.
- Engine manuals or online access.
- Replacement parts.
- Marine engines.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L9 Install & Service Steering Gear

Objectives:

To be competent in this area, the individual must be able to perform procedures to install, troubleshoot and service common steering systems.

LEARNING TASKS	CONTENT
1. Describe the types and function of rudders.	• Principles of steering • Types • Sail • Power • Tubes & glands • Bearings & stops
2. Install and service mechanical steering systems.	• Tillers • Cable & quadrant • Sailboat pedestals • Push-pull systems • Rod & gear
3. Install and service hydraulic steering systems.	• Helm pumps • Cylinders • Equalizers • Piping & valves • Lock-out valves • Power assist
4. Describe electrical steering systems.	• Autopilots • Thruster controls • Jog controls

Achievement Criteria:

Performance — The learner will describe and perform installation and service operations for common mechanical and hydraulic steering systems.

Conditions — The learner will require:

- Tools.
- Vessels with mechanical steering systems.
- Vessels with hydraulic steering systems.
- Replacement parts for steering systems.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L13 Install & Service Hydraulic Systems

Objectives:

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

- Describe the components of hydraulically operated equipment.
- Perform routine installation and servicing procedures.

LEARNING TASKS	CONTENT
1. Describe the components and function of basic hydraulic systems.	• Hydraulic system theory • Components of hydraulic systems: o - Pumps o - Reservoirs o - Lines o - Actuators o - Valves and controls o - Hydraulic oils
2. Perform routine installation procedures for hydraulic systems.	• Installation procedures for hydraulic pumps: o - Engine driven pumps o - Electrically driven pumps • Make up and installation procedures for lines: o - Flexible hydraulic lines and terminals o - Solid hydraulic lines and terminals o - Making up lines and terminals • Hydraulic cylinders • Hydraulic motors • Oil fill and start up procedures
3. Perform routine troubleshooting and servicing procedures for hydraulic systems.	• Checking hydraulic systems for leaks, damage and malfunction • Replacing hoses, seals, etc. • Bleeding hydraulic systems • Troubleshooting hydraulic systems.

Achievement Criteria:

Performance — The learner will describe hydraulic system components, make up hydraulic lines and install common hydraulically operated equipment on vessels.

Conditions — The learner will require:

- Tools.
- Marine hydraulic equipment.
- Manufacturer's manuals.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): N FASTENINGS & INSTALLATIONS

Competency: N1 Install Hardware & Fittings

Objectives:

To be competent in this area, the individual must be able to install typical marine hardware onto vessel decks and hulls.

LEARNING TASKS	CONTENT
1. Identify and describe fittings and equipment that are commonly installed on topsides or decks.	• Marine hardware: o - Cleats o - Winches o - Blocks o - Rails and tracks o - Stanchions o - Windows/hatches o - Canvas hardware o - Miscellaneous hardware
2. Install fittings on single skin and cored composite structures.	• Assessing load size & direction • Reinforcing options for composite structures • Fastener installations in composites • Bedding and sealing • Installing framed windows & hatches
3. Install fittings on wood structures.	• Reinforcing options for wood structures • Fastener installations in wood • Bedding & sealing
4. Install fittings on metal structures.	• Inserts • Welded fittings • Fastenings • Compatibility of metals

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. • A work place or training environment.
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout the entire task • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements

LINE (GAC): N FASTENINGS & INSTALLATIONS

Competency: N2 Install Thru-Hulls & Underwater Equipment

Objectives:

To be competent in this area, the individual must be able to select and install thru-hull fittings and underwater equipment in wood, metal and composite hulls.

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 o - Single skin composite structure o - Cored composite structure o - Wood hulls o - Steel and aluminum hulls
4. Install miscellaneous underwater fittings and fasteners.	• Installing transducers, trim tabs, etc. on composite & wood hulls

Achievement Criteria:

Performance — The learner will describe appropriate thru-hull fittings for the application and perform installation procedures in composite, wood and metal hull materials.

Conditions — The learner will require:

- Tools.
- Thru-hull fittings.
- Marine substrates.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): O ELECTRICAL SYSTEMS

Competency: O5 Describe Battery Installations

Objectives:

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

- Describe marine batteries.
- Describe installation and servicing procedures.

LEARNING TASKS	CONTENT
1. Describe battery capacity, performance and selection for marine applications.	• Battery capacities • Wet cells & gel cells • Battery chemistry & cycling • Battery applications for marine use • Battery selection considerations
2. Describe the factors to consider when locating and installing batteries in the vessel.	• Battery location considerations • Secure installation, battery boxes, ventilation • Battery cable installation • Preparing a new battery for use
3. Describe procedures for battery servicing.	• Hydrometer use • Testing and troubleshooting charging system output • Topping up wet cells • Cleaning terminals • Load testing
4. Describe hazards associated with 12V batteries.	• Lifting & carrying • Hydrogen gas explosions • Acid spills • “Dead” shorts
5. Describe various battery charging methods.	• Alternators & generators • 110v chargers
6. Describe common reasons for battery discharge and failure.	• Overcharging • Sulphating • Surface shorting • Corrosion and poor connections

LINE (GAC): Q MISCELLANEOUS INSTALLATIONS

Competency: Q4 Describe Propane Distribution Systems

Objectives:

To be competent in this area, the individual must be able to describe the safe installation of propane tanks and associated fuel supply lines.

LEARNING TASKS	CONTENT
1. Describe basic properties of propane and the safety hazards associated with its use.	• Density • Flammability • Odour • Pressure • Safety issues
2. Describe the basic code requirements for gas installations.	• Regulatory bodies • ABYC standards
3. Describe the installation of propane tanks and fuel supply lines.	• Propane tank containment • Piping & distribution lines • Regulators & pressure valves • Solenoids & detectors • Controls

LINE (GAC): Q MISCELLANEOUS INSTALLATIONS

Competency: Q5 Install & Service Heating Systems

Objectives:

To be competent in this area, the individual must be able to install and service typical vessel accommodation heating systems.

LEARNING TASKS	CONTENT
1. Describe common marine accommodation heating systems.	• Diesel, kerosene • Propane • Forced hot air • Hot water • Galley stoves
2. Select, install and service natural draft marine heating systems and galley stoves.	• Diesel, kerosene stove installation & troubleshooting • Alcohol stoves • Propane stoves*
3. Select, install and service forced air and hot water marine heating systems.	• Forced hot air heater installation & troubleshooting • Hot water heating installation & troubleshooting

Achievement Criteria:

Performance — The learner will install and service typical vessel accommodation heating systems.

*Note: Installation of propane fired equipment is **not** a requirement of this competency.

Conditions — The learner will require:

- Tools.
- Vessels with heating systems.
- Heating equipment.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): Q MISCELLANEOUS INSTALLATIONS

Competency: Q6 Install & Service Refrigeration & A/C Systems

Objectives:

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

- Install and service typical vessel refrigeration.
- Install and service self contained A/C systems.

LEARNING TASKS	CONTENT
1. Select, install and service marine domestic refrigeration systems.	• Principles of refrigeration • Selection considerations • Ice box construction & installation • Electrical systems and requirements • 12V freezers • Compressor and component installation • Troubleshooting and service
2. Select, install and service self contained vessel air conditioning systems.	• Selection considerations • Power requirements • Compressors • Cooling systems • Ducting • Controls & power service

Achievement Criteria:

Performance — The learner will select, install, troubleshoot and service marine domestic refrigeration and self contained air conditioning systems.

Conditions — The learner will require:

- Tools.
- Vessels with refrigeration systems.
- Refrigeration equipment.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

Marine Service Technician

Level 4

LINE (GAC): B YARD MANAGEMENT

Competency: B1 Describe Boatyard Business Practices

Objectives:

To be competent in this area, the individual must be able to describe the basics of boatyard business practices and procedures.

LEARNING TASKS	CONTENT
1. Describe the nature and future trends of the marine repair industry.	• Scope of the marine repair industry • Current issues & challenges • Trends in the development of the industry
2. Describe the basic principles of boatyard economics.	• Relationships between sales, overheads, wages, materials costs, taxes, capital investment, profit, etc. • Wages and benefits, legal responsibilities of employer & employee
3. Describe the key components of contracts and describe the legal responsibilities.	• What is a contract • Estimates & quotations • Responsibilities of yard & customer • Liens and formal dispute resolution
4. Describe estimating and the procedure for processing customer's orders and associated workflow.	• Repair estimates • Operating procedures • Steps in work flow • Record keeping
5. Describe project planning for major repair work.	• Procedures • Schedules • Facility • Materials • Labour allocation

LINE (GAC): B YARD MANAGEMENT

Competency: B3 Describe the Principles of Quality Assurance

Objectives:

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

- Describe the basic principles of quality assurance systems.
- Describe how they are implemented and maintained.
- Describe information sources related to lawful and professional standards.

LEARNING TASKS	CONTENT
1. Describe the basic principles of quality assurance systems.	• Objectives of QA • Customer satisfaction • Standards • Procedures • Training • Record keeping • Inspection & quality control
2. Describe the regulatory agencies that govern the installation of marine electrical equipment.	• ABYC • NFPA • CSI
3. Describe sources of technical support regarding correct installation of marine electrical equipment.	• Accessing information from manufacturers • Accessing information from ABYC

LINE (GAC): B YARD MANAGEMENT

Competency: B4 Describe Role of Surveyors & Insurance Adjusters

Objectives:

To be competent in this area, the individual must be able 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: B6 Control Projects

Objectives:

To be competent in this area, the individual must be able to plan, lead and review multi-stage marine repair projects of several weeks duration given management developed estimates and clear technical standards.

LEARNING TASKS	CONTENT

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

2. Control project throughout repair process.	• Basic control mechanisms.
	• Schedule preservation
	  o Planned versus actual events
	  o Updating timelines
	  o Personnel responsibilities
	  o Contingencies
	  o Reporting progress/problems

3. Review completed projects and provide feedback.	• Feedback process
	  o Unplanned work
	  o Over-runs
	  o Work process modifications
	• Documentation
	• Communications with management

Achievement Criteria:

Performance — The learner will plan, lead and review multi-stage marine repair projects of several weeks duration given management developed estimates and clear technical standards.

Conditions — The learner will require:

- Projects.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): C YARD PRACTICES

Competency: C1 Describe Environment Protection Practices

Objectives:

To be competent in this area, the individual must be able to describe the principles of sound environmental protection practices in the boatyard workplace.

LEARNING TASKS	CONTENT
1. Describe good housekeeping practices for preventing environmental pollution.	• Best Management Practices program • Surface preparation residues • Coatings storage, application & disposal • Waste fluids handling and disposal • Dust and overspray management • Chemical & petroleum storage • General yard maintenance • Record keeping • Training
2. Identify regulatory agencies responsible for enforcing environmental regulations.	• Environment Canada • Fisheries and Oceans Canada • Provincial and municipal authorities

LINE (GAC): C YARD PRACTICES

Competency: C3 Describe Principles of Vessel Salvage

Objectives:

To be competent in this area, the individual must be able to describe the methods and procedures for salvaging sunken, capsized or beached vessels.

LEARNING TASKS	CONTENT
1. Describe the methods and procedures for salvaging a sunken vessel.	• Job assessment • Cost/value consideration • Lift planning • Equipment options • Use of divers • Safety • Environmental considerations
2. Describe the methods and procedures for righting a capsized vessel.	• Cranes • Air bags • Maintaining buoyancy
3. Describe the procedure for salvaging beached vessels.	• Re-floating beached sailing vessel • Re-floating beached power vessel • Patching techniques • Pumping • Tide considerations • Winching & towing

LINE (GAC): G MATERIALS

Competency: G5 Identify Thermoplastics & Demonstrate Basic Handling Techniques

Objectives:

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

- Identify common thermoplastic materials used for marine applications.
- Perform basic machining techniques.

LEARNING TASKS	CONTENT
1. Identify and describe common thermoplastic materials and their properties.	• Acrylic • Polycarbonate • Teflon® • Polyethylene • Nylon • Bearing materials • Handling & storage of thermoplastics
2. Perform basic machining operations in thermoplastics.	• Techniques for cutting & drilling thermoplastics
3. Describe the common procedures for forming and bonding thermoplastic components.	• Forming options • Bonding & sealing
4. Describe the installation of thermoplastic windows.	• Cutting to a template • Drilling and fastening • Sealing

Achievement Criteria:

Performance — The learner will identify and describe the characteristics of typical thermoplastic materials used in the marine workplace and demonstrate drilling and cutting techniques.

Conditions — The learner will require:

- A representative sample of common thermoplastic materials.
- Stock thermoplastic material.
- Tools and equipment.
- A work place or training environment.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): H FABRICATION

Competency: H3 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/glass 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 • Laminating & curing conditions • Resin & reinforcement choices • Sheathing procedures • 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 with polyester • Lay-up schedule & procedures • Filling & fairing • Finishing coatings

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.
- A work place or training environment.

Criteria The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

LINE (GAC): H FABRICATION

Competency: H5 Perform Cold Molding Operations

Objectives:

To be competent in this area, the individual must be able to perform 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 • Glues • Sheathing techniques • Vacuum bagging • Appropriate wood types • Planking methods • Framing options • Frameless construction
2. Carry out cold molding construction.	• Safety • Mold construction • Materials preparation • Planking lay up • Completion and fairing
3. Make repairs to cold molded structures.	• Damage assessment • Surface damage • Structural damage • Rot repair

Achievement Criteria:

Performance — The learner will undertake cold molding operations to construct major vessel components and make repairs to cold molded structures.

Conditions — The learner will require:

- Tools.
- Wood stock materials.
- Molds/forms.
- Composites resins and reinforcements.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): H FABRICATION

Competency: H6 Perform Wood Lamination Operations

Objectives:

To be competent in this area, the individual must be able to perform typical wood lamination techniques.

LEARNING TASKS	CONTENT
1. Describe appropriate applications for laminated wood structures.	Wood lamination applications: • Beams • Spars • Frames • Keels • Stems • Knees
2. Build laminated wood components by strip laminating.	• Selecting woods • Glues & gluing procedures • Jig making • Clamping • Cleaning/finishing
3. Build laminated wood components using vacuum bagging techniques.	• Vacuum bagging equipment & materials • Jigs • Vacuum bagging process
4. Replicate laminated components by using jigs and air pressure forming.	• Appropriate applications • Use of jigs & air equipment

Achievement Criteria:

Performance — The learner will construct laminated wood components using traditional methods and vacuum bagging.

Conditions — The learner will require:

- Tools.
- Wood materials.
- Forms and templates.
- Adhesives.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): J WOODWORK REPAIRS

Competency: J3 Perform Fairing & Cosmetic Operations in Wood

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.
- Perform high quality fairing and finishing operations.

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 bungs • Finishes
2. Perform fairing and finishing operations with quality wood components.	• Planing curved surfaces • Board sanding • Scraping • Power sanding • Finish sanding • Paints & varnishes

Achievement Criteria:

Performance — The learner will perform quality fairing and finishing on interior and exterior joinery and brightwork.

Conditions — The learner will require:

- Tools.
- Rough fabricated joinery components.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): K COMPOSITE REPAIRS

Competency: K6 Repair High Performance FRP Structures

Objectives:

To be competent in this area, the individual must be able to repair FRP structures using high performance materials.

LEARNING TASKS	CONTENT
1. Describe the characteristics of high performance materials and manufacturing techniques.	• Carbon fibre, Kevlar® • Other high performance fabrics • Epoxy & vinyl resin systems • Vacuum bagging • Resin wet-out systems • Hot bonders
2. Perform repairs to damaged high performance structures.	• Grinding Kevlar® & carbon fibre • Variations in taper • Dealing with cores • Materials preparation • Lay-up conditions & sequence
3. Use vacuum bag techniques for repair work.	• Sealing the surface • Bleeders & peel ply • Lamination materials & orientation • Post curing

Achievement Criteria:

Performance — The learner will perform repairs to structures built with high performance composite materials.

Conditions — The learner will require:

- Tools.
- Composites materials.
- High performance composite structures.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L14 Describe Alarms & Detectors

Objectives:

To be competent in this area, the individual must be able to describe mechanical and electrical alarms and detectors used for vessel safety.

LEARNING TASKS	CONTENT
1. Describe the function of built-in fire extinguishers.	• Built in fire extinguishing systems • Checking built in extinguishing systems
2. Identify and describe the function of detectors and alarms.	• Heat rise fire alarms • Smoke alarms • Gas & vapour detectors • Bilge water alarms • Burglar alarms
3. Describe mechanical and electrical alarm systems installations techniques.	• Selection of equipment • Location of sensors • Testing

LINE (GAC): L MECHANICAL SYSTEMS

Competency: L15 Describe Submerged Engine Salvage

Objectives:

To be competent in this area, the individual must be able to describe the procedures for salvaging engines that have been submerged in saltwater.

LEARNING TASKS	CONTENT
1. Describe planning and equipment required in advance of raising the vessel (engine).	• Job assessment & timeliness • Equipment list
2. Describe the damage likely to result from submersion.	• Effects of submersion in salt water • Effects of submersion in fresh water • Mechanical components • Electrical components
3. Describe the procedures for removing water, re-starting engine and preventing further deterioration.	• Lifting the engine • Draining & restarting • Preservatives • Requirements for rebuilding • Electrical components

LINE (GAC): M FINISHING & PAINTING

Competency: M3 Mark & Mask Waterlines & Stripes

Objectives:

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

- Mark and mask for hull stripes.
- Prepare surface.
- Use appropriate protective masking techniques in preparation for spray finishing.

LEARNING TASKS	CONTENT
1. Describe procedures for measuring, marking and masking hull stripes.	• Marking out a fair waterline given bow and stern positions • Marking out boot lines and cove stripes of constant visual width • Marking out curved hull stripes and graphics • Masking for hull stripes
2. Masking hulls and decks appropriately for spray painting.	• Masking with fine line tapes • Using masking machines • Masking with plastic and paper sheeting • Masking complete hull & deck areas for spray painting
3. Prepare surfaces for spray painting.	• Preparing surfaces for spray applications

Achievement Criteria:

Performance — The learner will mark out and mask for typical hull stripes and decorative graphics, mask and prepare for paint applications.

Conditions — The learner will require:

- Masking equipment.
- Measuring tools.
- Vessels on the hard.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): M FINISHING & PAINTING

Competency: M4 Describe Multi-Component Paint Systems

Objectives:

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

- Describe site preparation.
- Describe spray application methods for multi-component marine paint systems used with composites and metals.

LEARNING TASKS	CONTENT
1. Describe multi-component paint systems and their advantages and disadvantages.	• Epoxy • Polyurethane • Water borne
2. Describe the requirements regarding ambient working conditions for topcoat spraying and appropriate procedures for site preparation.	• Safety considerations • Temperature & moisture levels • Ventilation & shop conditions • Outside work • Masking materials
3. Describe surface preparation.	• Fibreglass surface preparation • Aluminum surface preparation • Steel surface preparation • Adhesion testing • New & previously painted surfaces • Paint compatibility
4. Describe the methods of spray application for multi-part paint systems.	• Safety equipment & procedures • Application equipment • Epoxy primers • Urethane topcoats • Measuring & mixing • Spraying procedures • Troubleshooting paint films

LINE (GAC): M FINISHING & PAINTING

Competency: M6 Select & Spray Multi-Component Topcoats

Objectives:

To be competent in this area, the individual must be able to paint large previously-prepared structures (hull, deck) using spray equipment and multi-component paints.

LEARNING TASKS	CONTENT
1. Evaluate the work and select equipment.	• Surface evaluation • Shop conditions • Safety considerations • Fluid tips, needles & air caps • Balancing the spray gun • Setting up air supply
2. Final preparation of surface for topcoat.	• Final surface cleaning • Shop conditions
3. Spray multi-component topcoats to a high gloss finish on hulls or other major components.	• Topcoat spray procedures & sequences • Additives • Non-skid surfaces • Troubleshooting equipment and finishes

Achievement Criteria:

Performance — The learner will select materials and equipment and spray multi-component topcoats onto large vessel surfaces that have been previously prepared for the painting operation.

Conditions — The learner will require:

- Compressor and spray equipment.
- Multi-component coatings.
- Vessels on the hard.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): M FINISHING & PAINTING

Competency: M7 Repair Multi-Component Topcoats

Objectives:

To be competent in this area, the individual must be able to plan and carry out repairs to damaged high-gloss multi-component coatings.

LEARNING TASKS	CONTENT
1. Describe techniques used to identify various paint types and test for adhesion.	• Identify multi-component paints • Identify single component paints • Adhesion testing
2. Recommend and plan appropriate repair procedures.	• Removal methods • Solvent stability • Fillers & fairing options • Primers • Topcoat spray techniques for repairs • Sanding & polishing
3. Spray repair to a damaged painted surface.	• Masking techniques for repairs • Spray sequence • Finishing options

Achievement Criteria:

Performance — The learner will assess damaged multi-component paint surfaces, select repair materials, prepare and spray repair coatings.

Conditions — The learner will require:

- Compressor and spray equipment.
- Multi-component coatings.
- Vessels on the hard.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): O ELECTRICAL SYSTEMS

Competency: O9 Install Marine Electronics

Objectives:

To be competent in this area, the individual must be able to install typical marine electronics equipment and systems.

LEARNING TASKS	CONTENT
1. Describe marine electronics.	• Sounders & fish finders • Logs • Radar • GPS & plotters • Computers • Radio & telephone communications • Weather instruments • NMEA connections • Power supply considerations
2. Install marine radios and equipment.	• Locating radio & equipment • Aerial installations & cabling • Ground plate setup
3. Install depth sounders and radars.	• Locating instrument & transducer • Cables & transducer installation
4. Install GPS and plotters.	• Locating instruments & aerials • Installation procedures • Computer interfaces • NMEA linkages and communications
5. Install weather instruments.	• Locating instruments & senders • Installation procedures.

Achievement Criteria:

Performance — The learner will install typical marine electronics into vessels.

Note: This competency is about equipment installation/hookup only and does **not** include troubleshooting/service to internal components of electronic equipment.

Conditions — The learner will require:

- Tools.
- Marine electronic equipment.
- Vessels.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): Q MISCELLANEOUS INSTALLATIONS

Competency: Q3 Install & Service Davits & Hoists

Objectives:

To be competent in this area, the individual must be able to install and service davits and hoists.

LEARNING TASKS	CONTENT
1. Describe typical davit and hoist systems.	• Mast & boom • Cantilever types • Twin stern davits • Manual, electric & hydraulic winches
2. Select and install davits and hoists.	• Selecting appropriate davits & hoists • Load calculations • Structural considerations • Installation procedures
3. Perform servicing operations on davits and hoists.	• Assessing davits & hoists for wear or damage • Lubricating, changing worn cables and other service procedures

Achievement Criteria:

Performance — The learner will select and install davits and hoist systems onto vessels and undertake repair and service operations.

Conditions — The learner will require:

- Tools.
- Lifting equipment.
- Vessels.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

Marine Service Technician

Advanced Workplace Based Only

(Advanced competencies that are workplace based only, no institutional level training component)

LINE (GAC): C YARD PRACTICES

Competency: C4 Operate Power and Sail Vessels

Objectives:

To be competent in this area, the individual must be able to operate, manoeuvre and dock power and sailing vessels over 25 feet in length in a marina environment.

LEARNING TASKS	CONTENT
1. Obtain a Canadian Pleasure Craft Operator Card.	• Requirements for PCOC
2. Interpret tide and current tables (where worker operates in tidal waters).	• Tide tables • Current tables & atlases
3. Manoeuvre and safely dock power and sail vessels over 25 feet long from one location to another at marina docks.	• Engine start up and shut down procedures • Casting off and manoeuvring from docks • Manoeuvring sailboats and inboard powered single-screw powerboats • Manoeuvring twin-screw power vessels and vessels with thrusters • Towing • Safe docking and securing procedures

Achievement Criteria:

Performance

The learner will operate a variety of vessels over 25 feet, power and sail, and perform safe manoeuvres in a marina environment.

Conditions

The learner will require:

- Single screw power vessels over 25'.
- Twin screw power vessels over 25'
- Sailing vessels over 25'.
- A marina environment.

Criteria

The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): C YARD PRACTICES

Competency: C5 Operate Straddle Lift Equipment

Objectives:

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

- Operate and manoeuvre straddle lift equipment (Travelift™) to lift out and launch typical large vessels in a boatyard.
- Set up blocking and jack stands to support vessels on the hard.

LEARNING TASKS	CONTENT
1. Operate straddle lift equipment.	• Controls and operations • Safety issues • Lifting out vessels – Tidal considerations (tidal waters only) – Vessel hull types – Sling positioning • Manoeuvring vessels in yard • Launching vessels
2. Set up blocking.	• Vessel types and structural considerations • Jack stands • Wood blocking materials • Drums • Bilge blocking for keel repairs • Safety considerations

Achievement Criteria:

Performance	The learner will operate straddle lift equipment to lift and launch a variety of vessels and block them securely in a boatyard.
Conditions	The learner will require: • Travelift™ equipment. • Vessels. • Blocking equipment. • A marina or boatyard environment
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout the entire task • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.***

LINE (GAC): G MATERIALS

Competency: G11 Select & Use Caulking Materials for Wood Vessels

Objectives:

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

- Select the materials and tools required.
- Perform caulking operations on traditional plank on frame hulls.

LEARNING TASKS	CONTENT
1. Prepare for caulking operations.	• Caulking theory • Plank on frame hulls • Deck construction
2. Perform caulking procedures.	• Seam design • Caulking materials • Caulking tools • Caulking sequence • Paying • Reefing & repairs

Achievement Criteria:

Performance The learner will select appropriate tools and materials and caulk traditional plank on frame hulls.

Conditions The learner will require:

- Caulking tools.
- Caulking materials.
- Plank on frame vessels.
- A work place.

Criteria The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): H FABRICATION

Competency: H2 Fabricate Advanced FRP Tooling

Objectives:

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

- Fabricate complex plugs.
- Build production tooling from plugs.

LEARNING TASKS	CONTENT
1. Fabricate plugs with complex profiles.	• Design considerations for complex shapes • Vacuum & release flanges • Modifying existing components • CAD machining • New construction (one off) options
2. Fair and finish plugs to a molding surface.	• Fairing techniques • Material selection & application • Surface finish & polishing • Release system • Plug curing
3. Build production quality molds.	• Parting lines & mating flanges • Materials choices • Gel coat application • Skin and lay-up procedures • Fabrication sequence • Cores & laminate stiffening • Frameworks for dimensional stability • Mold mobility • Mold curing
4. Prepare production molds for lay-up.	• Surface finishing • Release systems • Splash & mold cure • Mold storage

Achievement Criteria:

Performance	The learner will build complex plugs from a variety of materials and use plugs to build production molds.
Conditions	The learner will require: • Tools. • Plug and mold building materials. • Composites materials. • A work place.
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout the entire task • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.***

LINE (GAC): H FABRICATION

Competency: H7 Perform Joinery Operations

Objectives:

To be competent in this area, the individual must be able to plan and build wood interior and exterior yacht joinery work.

LEARNING TASKS	CONTENT
1. Fabricate common joints and joinery.	• Common joint construction • Cabinets • Drawers • Doors • Soles • Tables • Coamings and rails
2. Design typical interior woodwork and exterior wood features for a modern yacht.	• Interior joinery • Exterior joinery • Wood selection for applications
3. Plan interior design and layout.	• Practicalities of accommodation layout • Aesthetics of joinery work

Achievement Criteria:

Performance: The learner will fabricate interior and exterior yacht quality joinery work.

Conditions: The learner will require:

- Woodworking tools.
- Assorted hardwoods.
- Plywoods and veneers.
- A work place.

Criteria: The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): H FABRICATION

Competency: H8 Install and Repair Teak Decking

Objectives:

To be competent in this area, the individual must be able to remove, repair and install new teak decks.

LEARNING TASKS	CONTENT
1. Remove damaged teak decking.	• Fastened decking • Glued decking • Sub-deck assessment and repair
2. Repair and install teak decking.	• Repairs to individual planks/strips • Complete replacement
3. Lay out and install new teak decks.	• Layout and aesthetic factors o Curves o Mirroring • Materials selection • Assembly and application • Vacuum bagging techniques • Caulking and finishing

Achievement Criteria:

Performance: The learner will repair, replace and install teak decking.

Conditions: The learner will require:

- Tools.
- Vessels with teak decks.
- A work place.

Criteria: The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): I MARINE METALS

Competency: I2 Weld Marine Metals

Objectives:

To be competent in this area, the individual must be able to set up and perform TIG and MIG welding operations with typical marine metals.

LEARNING TASKS	CONTENT
1. Prepare for welding operations.	• Bevelling • Edge preparation • Sleeving and butt welding
2. Perform welding operations.	• TIG welding – Aluminum – Stainless steel • MIG welding – Aluminum
3. Fair and finish welds.	• Filing and fairing welds • Pickling and polishing welds

Achievement Criteria:

Performance: The learner will prepare metal components for welding and use TIG and MIG equipment to weld stainless and aluminum components.

Conditions: The learner will require:

- Metalworking tools.
- TIG welding equipment.
- MIG welding equipment.
- Stock marine metals.
- A work place.

Criteria: The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): I MARINE METALS

Competency: I3 Fabricate with Marine Metals

Objectives:

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

- Design typical marine industry structures.
- Plan and lay out for fabrication.
- Cut, shape and bend marine metals and prepare for welding.
- Finish completed components ready for installation.

LEARNING TASKS	CONTENT
1. Plan and design typical marine components.	• Purpose and nature of typical marine metal hardware • Design considerations • Materials selection • Layout procedures • Jig building • Fabrication procedures • Weld preparation
2. Cut and shape stock materials.	• Cutting • Filing • Grinding • Drilling • Tapping and thread cutting
3. Bend pipe and tubing.	• Pipe bending • Tube bending
4. Prepare components for welding.	• Plate stock bending • Edge prepping • Tacking
5. Finish metal components.	• Sanding • Polishing • Preparing aluminum for anodizing

Achievement Criteria:

Performance	The learner will plan, lay out and perform fabrication operations for typical applications in marine metals. Note: This competency does **not** include welding.
Conditions	The learner will require: • Metalworking tools. • Bending equipment. • Stock marine metals. • A work place.
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout the entire task • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.***

Line (GAC): L MECHANICAL SYSTEMS

Competency: L12 Repair & Adjust Propellers

Objectives:

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

- Repair propeller damage.
- Balance and adjust propellers.

LEARNING TASKS	CONTENT
1. Repair damaged propellers.	• Checking balance • Straightening bent blades • Adding or removing material • Changing hubs on aluminum props
2. Adjust propeller balance, diameter and pitch.	• Assessing performance history and requirements • Reducing propeller diameter • Balancing • Adjusting blade weight • Adjusting and altering pitch

Achievement Criteria:

Performance: The learner will repair damaged propellers and adjust propeller balance, diameter and pitch.

Conditions: The learner will require:

- Tools.
- Specialty propeller adjustment tools.
- Propellers.
- A work place.

Criteria: The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): M FINISHING & PAINTING

Competency: M1 Apply Coatings by Brush and Roller

Objectives:

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

- Apply marine paints, varnishes and other coatings using brush techniques.
- Apply marine paints, varnishes and other coatings using roller techniques.

LEARNING TASKS	CONTENT
1. Perform techniques for preparing surfaces for paint or varnish application.	• Removing previous coatings • Cleaning • Sanding • Priming • Undercoating
2. Perform procedures for paint and varnish coatings by brush.	• Ambient conditions • Mixing & thinning • Selecting brushes • Application technique • Care of brushes for paint & varnish
3. Perform procedures for paint and varnish coatings by roller.	• Roller selection • Application technique

Achievement Criteria:

Performance	The learner will apply typical paints, varnishes and coatings using brush and roller techniques.
Conditions	The learner will require: • Painting tools. • Assorted coatings. • Assorted substrates or vessel components. • A work place or training environment.
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout the entire task • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements

LINE (GAC): M FINISHING & PAINTING

Competency: M5 Prep & Prime for Multi-Component Topcoats

Objectives:

To be competent in this area, the individual must be able to prepare FRP and metal surfaces by abrading, fairing and priming in readiness for topcoat applications.

LEARNING TASKS	CONTENT
1. Fair, abrade and prime FRP surfaces.	• Fairing materials and techniques • Abrading surfaces o Achieving fairness o Preparation for topcoats • Priming
2. Fair, abrade and prime steel surfaces.	• Fairing materials and techniques • Sealing and priming
3. Fair, abrade and prime aluminum surfaces.	• Fairing materials and techniques • Sealing and priming

Achievement Criteria:

Performance: The learner will perform fairing and preparation work for gloss topcoat sprays on FRP, steel and aluminum surfaces.

Conditions: The learner will require:

- Abrasive tools.
- Air compressor and spray equipment.
- FRP vessels.
- Metal vessels.
- A work place.

Criteria: The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): M FINISHING & PAINTING

Competency: M8 Brush-Apply Gloss Paints & Varnishes

Objectives:

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

- Use brush and roller techniques to achieve high gloss paint finishes.
- Use brush and roller techniques to achieve gloss varnish finishes on wood.

LEARNING TASKS	CONTENT
1. Use brush and roller techniques to apply high gloss paints by hand.	• Preparation techniques for paint • Brushes • Rollers • Conventional enamel type paints • Multi-component paints • Painting techniques
2. Use brush and roller techniques to apply high gloss varnish to joinery and brightwork.	• Preparation techniques for varnish • Brushes for varnish • Varnishes and additives • Varnishing techniques

Achievement Criteria:

Performance The learner will prepare surfaces and apply high gloss paints to various substrates, and apply varnish to high quality joinery and brightwork.

Conditions The learner will require:

- Painting tools.
- Assorted gloss paints and varnishes.
- Joinery components.
- Vessels.
- A work place.

Criteria The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): O ELECTRICAL SYSTEMS

Competency: O4 Troubleshoot & Service Starting & Charging Systems

Objectives:

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

- Troubleshoot service and repair engine starting equipment.
- Troubleshoot service and repair engine driven alternators and charging equipment.

LEARNING TASKS	CONTENT
1. Troubleshoot alternators.	• Alternator function • Alternator types • Troubleshooting techniques • Servicing alternators
2. Troubleshoot starters and starter solenoids.	• Starter motors • Starter solenoids • Troubleshooting techniques • Servicing starters
3. Troubleshoot engine starting circuits.	• Ignition and starter switches • Starting circuit solenoids • Troubleshooting starter circuit wiring

Achievement Criteria:

Performance — The learner will troubleshoot engine mounted alternators and charging circuits, starters, solenoids and associated electrical equipment.

Conditions — The learner will require:

- Tools.
- Electrical test equipment.
- Manufacturer's specifications.
- ABYC standards or online access to the standards.
- Starting and charging system components.
- Electrical wire and terminals.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): O ELECTRICAL SYSTEMS

Competency: O6 Install & Service DC Power Supply Systems

Objectives:

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

- Plan 12V power delivery systems.
- Select and install electrical power supply equipment.

LEARNING TASKS	CONTENT
1. Calculate vessel power requirements.	• Typical vessel power requirements and loads • Calculating battery and charging requirements • ABYC Standards
2. Select and install house batteries.	• Battery selection • Battery installations • ABYC Standards
3. Select and install charging equipment and switching.	• Alternators • Charging controllers (Echo Charger®, Pathfinder®, etc.) • Battery switching devices
4. Select and install inverters.	• Function of inverters • Inverter selection
5. Select and install alternate power sources.	• Solar panels • Wind generators

Achievement Criteria:

Performance — The learner will plan installations, select and install batteries, charging systems and associated equipment to meet house DC supply requirements.

Conditions — The learner will require:

- Tools.
- Electrical test equipment.
- Manufacturer's specifications.
- ABYC standards or online access to the standards.
- DC power supply components.
- Electrical wire and terminals.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): O ELECTRICAL SYSTEMS

Competency: O7 Install & Service DC Distribution Systems

Objectives:

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

- Lay out, install and troubleshoot DC panels.
- Lay out, install and troubleshoot distribution to equipment in the vessel.

LEARNING TASKS	CONTENT
1. Select DC distribution equipment, panels, wiring and switching.	• Distribution panels • Sub-panels • Circuit protection • ABYC standards
2. Install distribution panels.	• Distribution panel installations • Device layout • Labelling
3. Install distribution wiring.	• Conductor sizing • Routing and securing conductors • Grounding • Testing and troubleshooting

Achievement Criteria:

Performance: The learner will plan, select and install DC distribution panels and conductors to supply vessel power requirements.

Conditions: The learner will require:

- Tools.
- Electrical test equipment.
- Manufacturer's specifications.
- ABYC standards or online access to the standards.
- DC power distribution components.
- Electrical wire and terminals.
- A work place.

Criteria: The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): O ELECTRICAL SYSTEMS

Competency: O8 Install & Service Inverters & Onboard AC Systems

Objectives:

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

- Install and service inverters.
- Install and service AC distribution panels.
- Install and service shore power equipment.
- Install and service generators and related 120VAC equipment.

LEARNING TASKS	CONTENT
1. Calculate loads and determine vessel AC power requirements.	• ABYC Standards • Panels & distribution systems • Safety considerations • Electrolysis considerations
2. Select and install AC shore power equipment and inverters.	• Shore power hook ups • Panel and switching installations • Grounding and safety • Inverters
3. Select and install AC power generating equipment.	• Genset systems • Genset/shore power interface • Genset installation (electrical only)

Achievement Criteria:

Performance

The learner will plan, select and install AC shore power equipment and gensets.

Note: Genset installations include the electrical component only and **not** mechanical, engine related installations.

Conditions

The learner will require:

- Tools.
- Electrical test equipment.
- Manufacturer's specifications.
- ABYC standards or online access to the standards.
- AC power supply components.
- Inverters.
- Electrical wire and terminals.
- A work place.

Criteria

The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): P RIGGING INSTALLATIONS

Competency: P3 Install & Service Deck Hardware

Objectives:

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

- Select, lay out and install deck hardware for typical sailing vessel rigging.
- Service sailing vessel deck hardware.

LEARNING TASKS	CONTENT
1. Select and lay out deck hardware for sailboat rigging.	• Types & selection of winches • Selection of deck hardware o Sizing hardware for line size o Blocks and fairleads o Tracks o Pad eyes o Cleats • Layout considerations
2. Install hardware on decks.	• Service loads • Reinforcement of FRP, wood and metal deck structures • Isolating cores • Fasteners and installation
3. Service deck hardware.	• Winch servicing • Blocks and track hardware

Achievement Criteria:

Performance The learner will select sailing vessel deck hardware for racing and cruising rigs, and lay out, install and service hardware.

Conditions The learner will require:

- Tools.
- Assorted deck hardware.
- Sailing vessels.
- A work place.

Criteria The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): P RIGGING INSTALLATIONS

Competency: P4 Splice Lines

Objectives:

To be competent in this area, the individual must be able to make splices in various types of modern cordage.

LEARNING TASKS	CONTENT
1. Identify and select lines.	• Line materials and applications • Loads and line strength • Twisted line • Single braid • Double braid • High tech configurations
2. Make common splices in twisted and braided line.	• Types of splices • Twisted line • Braided line • High tech line • Splicing to anchor chain and hardware • Whipping, seizing and line terminations

Achievement Criteria:

Performance — The learner will select line for vessel applications and make splices in various types of cordage and materials.

Conditions — The learner will require:

- Splicing tools.
- Assorted line types.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): P RIGGING INSTALLATIONS

Competency: P5 Tune Rigging

Objectives:

To be competent in this area, the individual must be able to tune sailing vessel standing rigging for service requirements.

LEARNING TASKS	CONTENT
1. Tune racing and cruising sailing rigs.	• Tuning techniques • Static and dynamic tuning • Planning/organizing sea trials • Racing vessels • Cruising vessels • Helm balance • Sail shape

Achievement Criteria:

Performance

The learner will tune racing and cruising sailing rigs in static (at the dock) and dynamic (underway) situations.

Conditions

The learner will require:

- Tools.
- Various sailing vessels.

Criteria

The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): P RIGGING INSTALLATIONS

Competency: P6 Assemble Spars

Objectives:

To be competent in this area, the individual must be able to prepare and assemble spars and spar hardware from components supplied.

LEARNING TASKS	CONTENT

1. Assemble spar components.	• Masts, spreaders
	• Masthead
	  o Blocks and sheaves
	  o Aerials
	  o Electrical wiring and routing conductors
	• Mast foot and step hardware
	• Lighting and electronics mounting
	• Booms and other spars
	• Sail tracks
	• In-spar roller furling equipment
	• Fasteners and equipment installation to spars

Achievement Criteria:

Performance The learner will assemble sailing vessel spars and related hardware.

Conditions The learner will require:

- Tools.
- Assorted spar components.
- A work place.

Criteria The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

LINE (GAC): P RIGGING INSTALLATIONS

Competency: P7 Service & Repair Carbon Spars

Objectives:

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

- Inspect and evaluate carbon spars for damage or deterioration.
- Perform repairs to damaged carbon spars.

LEARNING TASKS	CONTENT

1. Assess structural and cosmetic damage to carbon spars.	• Structural evaluation techniques
	  o Visual inspection
	  o Laminate removal
	  o Damaged fastener holes
	• Cosmetic (surface) damage

2. Repair damaged carbon spars.	• Removing damaged materials
	• Materials selection
	• Tapers
	• Laminating procedures
	  o Open laminating
	  o Vacuum procedures
	• Curing procedures
	• Finishing

3. Modify/reinforce spars for equipment and hardware installation.	• Calculating load requirements • Planning for structural modification • Materials selection

Achievement Criteria:

Performance	The learner will evaluate structural and cosmetic damage to carbon spars, make damage repairs and modifications related to hardware installations.
Conditions	The learner will require: • Tools. • High performance composite resins and reinforcements. • Carbon spars. • A work place.
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout the entire task • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.***

LINE (GAC): Q MISCELLANEOUS INSTALLATIONS

Competency: Q7 Service & Repair Inflatable Vessels

Objectives:

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

- Inspect and perform routine maintenance procedures on inflatable structures.
- Repair damaged inflatable tubes.

LEARNING TASKS	CONTENT
1. Evaluate inflatable vessel components for damage and maintenance work.	• Fabric deterioration • Failure of adhesion and seams • Wear from abrasion • Holes and tears • Evaluation of metal components • Evaluation of FRP components
2. Perform routine maintenance procedures.	• Cleaning and stain removal • Protective coatings • Minor repairs to released adhesive bonds • Attachment of hardware and patches • Removal/replacement of inflatable tubes to rigid structures
3. Repair inflatable materials and structures.	• Re-bonding seams • Patching holes and tears • Reinforcements

Achievement Criteria:

Performance — The learner will assess inflatable vessels for routine maintenance and repair, perform maintenance procedures and perform repairs to damage inflatable structures.

Conditions — The learner will require:

- Tools.
- Fabrics and adhesives.
- Inflatable vessels.
- A work place.

Criteria — The learner will be competent once the performance criteria is met:

- Followed safe work practices throughout the entire task
- Conducted in a logical manner
- Conducted according to manufacturer's specifications
- Conducted according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts.

Section 4

TRAINING PROVIDER STANDARDS

Facility Requirements

CLASSROOM AREA

- Recommended 2.5 Sq. meters per student
- Projection screen, multimedia projector, whiteboard or similar
- Seating and tables suitable for lecturing
- Compliance with all safety codes

SHOP AREA

- Recommended 25 Sq. meters per student
- Meet all safety and fire, and envirmental codes
- Good lighting
- Approved ventilation systems

LAB REQUIREMENTS

- Recommended 10 Sq. meters per student

STUDENT FACILITIES

- 1 locker per student, study areas, food facility, hand wash facility, washroom facility.

INSTRUCTOR'S OFFICE SPACE

- Recommended 3.5 Sq. Meters

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

SAFETY EQUIPMENT (SUPPLIED BY SCHOOL)

- eye protection
- hearing protection
- rubber gloves
- dust mask

Safety Equipment (supplied by student)

- respirator with VOC cartridge
- coveralls
- safety shoes

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
  o

STUDENT EQUIPMENT (SUPPLIED BY SCHOOL)

- eye protection
- hearing protection
- rubber gloves
- dust mask

Safety Equipment (supplied by student)

- respirator with VOC cartridge
- coveralls
- safety shoes

LEVEL 3

SHOP EQUIPMENT

Required

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

Recommended

- thickness planer
  o

SHOP (FACILITY) TOOLS

Standard Tools

- assorted resin mixing containers
- stir sticks
- shears
- squeegee
- laminate roller
- sanding block
- sander/polisher
- buffing pads
- slot screwdriver
- Robertson screwdriver
- Phillips screwdriver
- box wrench set
- socket wrench set
- allen key set
- adjustable wrench
- standard pliers
- needle nose pliers
- 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

Safety Equipment (supplied by student)

- respirator with VOC cartridge
- coveralls
- safety shoes

LEVEL 4

SHOP EQUIPMENT

- 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)

Required

- eye protection
- hearing protection
- rubber gloves

Safety Equipment (supplied by student)

- respirator with VOC cartridge
- coveralls
- safety shoes

Learning Resources

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

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

Instructors 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 instructors also possess the following:

- Teaching experience in adult learning settings
- Diploma or certificate of completion in an adult education training program
- ABYC certification