Apprenticeship Manitoba

Manitoba

Marine and Outdoor Power Equipment Technician Level 2

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Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Unit: B2 Trade Mathematics II

Level: Two

Duration: 16 hours

Theory: 16 hours

Practical: 0 hours

Overview:

This unit is designed to provide the apprentice with the knowledge and ability to apply mathematics with precision, resourcefulness and confidence. This unit, which builds on the course Trade Mathematics I, is intended to provide the apprenticeship with ample opportunity to build on general mathematical concepts. Beginning with a review of trade-related calculations for occupational skills, the unit covers trade-related calculations for the diagnosis and repair of various components of marine and outdoor power equipment products. Marine and outdoor power equipment have evolved to become more sophisticated and complex. It follows that procedures used to diagnose and repair such equipment have also evolved to become more sophisticated, often requiring higher precision measuring tools. While marine and outdoor power equipment technicians will often depend on analog and digital measuring devices, technicians will encounter situations in their daily work where they will have to perform calculations and correctly apply formulas.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Perform trade-related calculations for occupational skills. a. Use and testing of diagnostic tools b. Conversion between imperial and metric system	**5%**
2. Perform trade-related calculations for the diagnosis and repair of engine and engine support systems. a. Work b. Horsepower c. Torque d. Engine cubic inch displacement e. Compression ratio	**20%**
3. Perform trade-related calculations for the diagnosis and repair of drivetrains.	**20%**
4. Perform trade-related calculations for the diagnosis and repair of fuel and exhaust systems. a. Fuel mix ratios	**15%**
5. Perform trade-related calculations for the diagnosis and repair of chassis, steering, suspension, braking systems and tires. a. Brake pad thickness-effectiveness b. Tire pressure	**15%**

6. Perform trade-related calculations for the diagnosis and repair of electrical and electronic components. **20%**

a. Ohm's law
b. Series circuits
c. Parallel circuits

7. Perform trade-related calculations for the diagnosis and repair of electrical and electronic components. **5%**

a. Chain pitch
b. Flow rate

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Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Unit: C2 Fundamentals of Two-Stroke Cycle Engines

Level: Two

Duration: 26 hours

Theory: 0 hours

Practical: 26 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about the principles of two-stroke cycle engines found in today's marine and outdoor power equipment. Beginning with an overview of related two-stroke engine terminology, this unit covers the main components of a two-stroke engine, the principles of operation and applications of this type of engine and the procedures for troubleshooting and repairing such an engine. There is a trend towards larger displacement, higher output and lighter components. Manufacturers' tolerances are tighter and engines have benefited from better engineering and design, better lubricants and new materials and technologies.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Review terminology associated with two-stroke cycle engines.	**10%**
2. Review the main components of a two-stroke cycle engine.	**10%**
3. Review the principles of operation for a two-stroke cycle engine. a. Cylinder heads and subcomponents b. Valve systems and subcomponents c. Pistons and subcomponents d. Crankshaft/crankshaft assemblies and subcomponents e. Cooling systems and subcomponents f. Cross-scavenged vs. loop-scavenged	**10%**
4. Perform the overhaul procedures for two-stroke cycle engines. a. Cylinders b. Pistons c. Cooling system d. Cylinder block e. Crankcase f. Crankshaft g. Induction system h. Bearings	**30%**
5. Perform troubleshooting and repair procedures on two-stroke cycle engines. a. Diagnostic procedures	**40%**

b. Manufacturers' service specifications
c. Evaluation of component conditions
d. Identification of causes of failure

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Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Unit: C3 Fundamentals of Four-Stroke Cycle Engines

Level: Two

Duration: 45 hours

Theory: 0 hours

Practical: 45 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about the principles of four-stroke engines found in today's marine and outdoor power equipment. Beginning with an overview of related four-stroke engine terminology, this unit covers the main components of a four-stroke engine, the principles of operation and applications of this type of engine and the procedures for troubleshooting and repairing such an engine. There is a trend towards larger displacement, higher output and lighter components. Manufacturers' tolerances are tighter and engines have benefited from better engineering and design, better lubricants and new materials and technologies.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Review terminology associated with four-stroke engines.	**10%**
2. Review the main components of a four-stroke engine.	**10%**
3. Review the principles of operation for a four-stroke cycle engine. a. Cylinder heads and subcomponents • Factors that determine firing order of a multi-cylinder engine b. Valve systems and subcomponents • Valve types, including arrangement • Valve timing, including overlap c. Pistons and subcomponents d. Crankshaft/crankshaft assemblies and subcomponents e. Cooling systems and subcomponents	**10%**
4. Perform the overhaul procedures for four-stroke cycle engines. a. Cylinders b. Pistons c. Cooling system d. Cylinder block e. Crankcase f. Crankshaft g. Induction system h. Bearings i. Valve train	**30%**

5. Perform troubleshooting and repair procedures on four-stroke engines. 40%

a. Diagnostic procedures
b. Manufacturers' service specifications
c. Evaluation of component conditions
d. Identification of causes of failure

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Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Unit: F1 Frames and Structural Components

Level: Two

Duration: 7 hours

Theory: 7 hours

Practical: 0 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about the frames and structural components found in today's marine and outdoor power equipment. Beginning with an overview of terminology associated with frames and structural components, the unit covers the types of frames and materials used, their function, the inspection, evaluation and repair procedures for frames. Chassis, steering, suspension, brakes and tires on units have benefited from engineering enhancements. Marine products have incorporated improvements to hull design and components; ATVs and similar multi-wheeled vehicles have incorporated improved suspension technologies for enhanced handling and rider comfort. In addition to use of new tire compounds, the industry has begun to apply nanotechnologies.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with frames and structural components.	**20%**
2. Identify the types of frames and materials used for marine and outdoor power equipment. a. Frames • Backbone • Castings • Cradle • Fabricated sheet metal • Perimeter • Stamped • Tubing • Clamp bracket/swivel bracket b. Materials • Alloys (ferrous and non-ferrous) • Aluminum • Composites • Fiberglass • Steel	**20%**
3. Describe the function of frames and structural components. a. Relationship to steering geometry b. Manufacturers' specifications	**20%**

4. Describe procedures for inspection and evaluation of frames and structural components. **20%**

a. Measurements
   - Visual checks (for common defects such as cracks, fatigue and oxidation)
   - Alignment checks
   - Pressure tests

b. Evaluation of component conditions

c. Determine causes of component failure

5. Perform repair procedures for frames and structural components. **20%**

a. Manufacturers' specifications

b. Sensory inspection

c. Common causes of failure

d. Removal and replacement of components
   - Bearings, bushings, races, seals

e. Correct causes of component failure

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Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Unit: F3 Steering Systems II

Level: Two

Duration: 21 hours

Theory: 14 hours

Practical: 7 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about the steering systems found in today's marine and outdoor power equipment. This unit, which builds on the course Steering Systems I, is intended to provide the apprenticeship with ample opportunity to build on terminology and concepts learned in that course. Beginning with an overview of terminology associated with electronic and hydraulic steering systems, the unit covers the types of electronic and hydraulic steering systems used, their operation, their components, and the repair procedures for electronic and hydraulic steering systems. Chassis, steering, suspension, brakes and tires on units have benefited from engineering enhancements. Marine products have incorporated improvements to hull design and components; ATVs and similar multi-wheeled vehicles have incorporated improved suspension technologies for enhanced handling and rider comfort. In addition to use of new tire compounds, the industry has begun to apply nanotechnologies.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with electronic and hydraulic steering systems.	**10%**
2. Identify the types of electronic and hydraulic steering systems used for marine and outdoor power equipment.	**10%**
3. Describe the operation of the types of electronic and hydraulic steering systems.	**10%**
4. Identify the components of electronic and hydraulic steering systems. a. Electronic • Motors • Switches • Relays • Sensors b. Hydraulic • Discs • Seals • Fluids • Valves	**10%**
5. Identify electronic and hydraulic steering linkage types.	**10%**
6. Describe the repair procedures for electronic and hydraulic steering systems and	**10%**

their components.

a. Sensory inspection
b. Adjustments according to manufacturers' specifications
   - Caster
   - Camber
   - Toe in/out
   - Other adjustments
c. Common causes of failure (stress, water damage, shock load)

7. Perform inspection and evaluation of electronic and hydraulic steering systems and their components. 20%

a. Measurements
   - Adjustment checks
   - Preload
b. Evaluation of component conditions
c. Determine causes of component failure

8. Perform repair procedures on electronic and hydraulic steering systems and their components. 20%

a. Measurements
b. Adjustments according to manufacturers' specifications
   - Caster
   - Camber
   - Toe in/out
   - Other adjustments
c. Removal and replacement of components
   - Shafts, bearings, seals, cables and pulleys
b. Correct causes of component failure

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Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Unit: F4 Suspension Systems

Level: Two
Duration: 40 hours
Theory: 25 hours
Practical: 15 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about the suspension systems found in today's marine and outdoor power equipment. Beginning with an overview of terminology associated with suspension systems, the unit covers the types of suspension systems used, their operation and purpose, their components, spring construction, and the repair and servicing procedures for steering systems. Chassis, steering, suspension, brakes and tires on units have benefited from engineering enhancements. Marine products have incorporated improvements to hull design and components; ATVs and similar multi-wheeled vehicles have incorporated improved suspension technologies for enhanced handling and rider comfort. In addition to use of new tire compounds, the industry has begun to apply nanotechnologies.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with suspension systems.	**10%**
2. Identify the types of suspensions. a. Front suspensions b. Rear suspensions c. Solid axle d. Independent	**10%**
3. Describe the operation and purpose of suspensions.	**10%**
4. Identify components of suspension systems. a. Air fittings b. Bushings c. Seals d. Springs e. Valves f. Shocks g. Linkages h. Bladders i. Ball joints j. Struts k. A-arms	**10%**

l. Trailing arms
m. Swing arms
n. Others

5. Describe spring construction **10%**

a. Coil
b. Leaf
c. Torsion
d. Air

6. Describe the repair procedures for suspension systems and their components. **10%**

a. Sensory inspection
b. Manufacturers' specifications
c. Common causes of failure

7. Perform inspection and evaluation of suspension systems and their components. **20%**

a. Measurements
   - Fluid levels
   - Spring sag
   - Excessive play
   - Steering geometry (rake, trail, offset)
   - Pressure
b. Evaluation of component conditions
c. Determine causes of component failure

8. Perform repair procedures on suspension systems and their components. **20%**

a. Measurements
b. Manufacturers' specifications
   - Set tolerances
   - Other adjustments
c. Removal and replacement of components
   - Shafts, bushings, shocks, springs, fluids and bladders
d. Correct causes of component failure
e. Rebuilding of components
   - Shocks
   - Struts

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Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Unit: F5 Braking Systems

Level: Two

Duration: 34 hours

Theory: 20 hours

Practical: 14 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about the braking systems found in today's marine and outdoor power equipment. Beginning with an overview of terminology associated with braking systems, the unit covers the types of braking systems used, their operation and purpose, their components, and the repair and servicing procedures for steering systems. Chassis, steering, suspension, brakes and tires on units have benefited from engineering enhancements. Marine products have incorporated improvements to hull design and components; ATVs and similar multi-wheeled vehicles have incorporated improved suspension technologies for enhanced handling and rider comfort. In addition to use of new tire compounds, the industry has begun to apply nanotechnologies.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with braking systems.	**10%**
2. Describe braking systems commonly found on outdoor power equipment. a. Drum brakes b. Disk brakes c. Mechanical operation d. Hydraulic operation e. Electric brakes f. Inboard brakes g. Wheel mounted brakes h. Jackshaft mounting i. Other brakes (e.g., engine brake – blade brakes)	**10%**
3. Describe the operation and purpose of braking systems and their components.	**10%**
4. Identify components of braking systems. a. Master cylinder b. Brake line c. Caliper d. Brake pads e. Levers f. Cables g. Linkages	**10%**

h. Pivots
i. Springs

5. Describe marine and outdoor power equipment circuits. 10%

a. Electric trailer brake circuit

6. Describe the repair procedures for braking systems and their components. 10%

a. Sensory inspection
b. Manufacturers' specifications
c. Common causes of failure

7. Perform inspection and evaluation of braking systems and their components. 20%

a. Measurements
   - Run out
   - Thickness
   - Diameter
   - Free play
b. Evaluation of component conditions (worn, damaged, defective)
c. Determine causes of component failure

8. Perform repair procedures on braking systems and their components. 20%

a. Measurements
b. Manufacturers' specifications
   - Set tolerances
   - Other adjustments
c. Removal and replacement of components
   - Friction materials, rotors, drums, springs, pads, cables, pivots and drums
d. Correct causes of component failure

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Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Unit: G2 Electrical Principles II

Level: Two

Duration: 35 hours

Theory: 20 hours

Practical: 15 hours

Overview:

This unit is designed to provide the apprentice with the knowledge of the relevant electrical principles for working with today's marine and outdoor power equipment. This unit, which builds on the course Electrical Principles I, is intended to provide the apprenticeship with ample opportunity to build on electrical principles and terminology from that course. Beginning with an overview of terminology and concepts associated with the basic electrical circuit, the unit covers common electrical related calculations, the basic electrical circuit types and their faults, and marine and outdoor power equipment circuits. Electrical and electronic components on both marine and outdoor power equipment have benefited from engineering enhancements, from electronic shifting to digital ignitions and electronic operator controls. Consumer demand for higher levels of amenities and performance has resulted in availability of such features as command start, heated seats and block heaters.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Describe semi-conductors.	**10%**
2. Describe circuit faults.	**10%**
3. Describe sensing devices.	**10%**
4. Describe actuators.	**10%**
5. Describe multiplexing concepts.	**20%**
6. Demonstrate diagnostic concepts and procedures.	**40%**

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Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Unit: G4 Charging and Starting Systems

Level: Two

Duration: 28 hours

Theory: 14 hours

Practical: 14 hours

Overview:

This unit is designed to provide the apprentice with the relevant electrical systems knowledge (charging and starting systems) for working with today's marine and outdoor power equipment. Beginning with an overview of terminology and concepts associated with charging and starting systems, the unit covers the types of charging and starting systems, the generation of electricity by the charging system and its components, the testing and servicing procedures, and the inspection and repair procedures for the charging and starting systems. Electrical and electronic components on both marine and outdoor power equipment have benefited from engineering enhancements, from electronic shifting to digital ignitions and electronic operator controls. Consumer demand for higher levels of amenities and performance has resulted in availability of such features as command start, heated seats and block heaters.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with charging and starting systems.	**10%**
2. Describe the generation of electricity by an alternator and a generator. a. Permanent magnet single phase b. Permanent magnet three phase c. Electromagnetic rotor three phase	**10%**
3. Describe the types and components of charging and starting systems and their circuits.	**10%**
4. Describe marine and outdoor power equipment circuits. a. Charging circuit b. 12V starting circuit c. AC voltage starting motor d. Lighting circuits e. Warning light and instrumentation circuits f. Fuse and/or circuit breaker circuit g. Safety/interlock circuits	**10%**
5. Describe the testing and servicing procedures for charging and starting systems and their components. a. Sensory inspection b. Manufacturers' specifications	**10%**

c. Charging system components
   - Stator
   - Rotor
   - Rectifier assembly
   - Slip ring and brushes
   - Regulators
   - Integrated charging system control modules

d. Alternator and generator drive systems
   - Belts
   - Mounts
   - Other components

6. Perform inspection and evaluation of charging and starting systems. 25%

a. Measurements
   - Output voltage
   - Amperage

b. Evaluation of component conditions (faults, melted connectors, battery plate sulphation; burnt brushes, galled bearing surfaces, damaged starter gears)

c. Determine causes of component failure

7. Perform repair procedures on charging and starting systems. 25%

a. Measurements

b. Manufacturers' specifications

c. Removal and replacement of components

d. Correct causes of component failure

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Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Unit: G5 Ignition Systems I

Level: Two

Duration: 14 hours

Theory: 10 hours

Practical: 4 hours

Overview:

This unit is designed to provide the apprentice with the relevant electrical systems knowledge (ignition systems) for working with today's marine and outdoor power equipment. Beginning with an overview of terminology and concepts associated with starting and ignition systems, the unit covers the types of starting and ignition systems, their components, their testing and servicing procedures, and the inspection, evaluation and repair procedures for these systems. Electrical and electronic components on both marine and outdoor power equipment have benefited from engineering enhancements, from electronic shifting to digital ignitions and electronic operator controls. Consumer demand for higher levels of amenities and performance has resulted in availability of such features as command start, heated seats and block heaters.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology and concepts associated with ignition systems.	**15%**
2. Describe the types of ignition systems.	**15%**
3. Describe the components of ignition systems.	**15%**
4. Describe the testing and servicing procedures for ignition systems and their components.	**15%**
5. Perform inspection and evaluation of ignition systems. a. Measurements • Coil resistance • Pulse voltage • Air gap • Source voltage b. Evaluation of component conditions c. Determine causes of component failure (improper installation of battery, short circuit of wiring)	**20%**
6. Perform repair procedures on ignition systems. a. Measurements b. Manufacturers' specifications c. Adjustments • Spark plug gap, dwell and pulse coil air gap	**20%**

d. Removal and replacement of components
e. Correct causes of component failure (improper installation of battery, short circuit of wiring)

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Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Unit: H1 Operator Controls

Level: Two

Duration: 14 hours

Theory: 10 hours

Practical: 4 hours

Overview:

This unit is designed to provide the apprentice with the knowledge of the operator controls of today's marine and outdoor power equipment. Beginning with an overview of terminology and concepts associated with control boxes, this unit covers the types and functions of control boxes, the testing and servicing procedures, and the inspection, evaluation and repair procedures for control boxes and their related components. Control boxes and hydraulic systems on both marine and outdoor power equipment have benefited from engineering enhancements. There is an increasing use of electronic operator controls, which allow for more operational control aimed at enhancing use and operator enjoyment of the unit.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology and concepts associated with control boxes.	**15%**
2. Describe the types of control boxes. a. Electrical b. Mechanical c. Hand/foot	**15%**
3. Describe the function of the types of control boxes.	**15%**
4. Describe the testing and servicing procedures for control boxes and their related components.	**15%**
5. Perform inspection and evaluation of control boxes and related components. a. Manufacturers' specifications b. Measurements c. Evaluation of component conditions d. Determine causes of component failure	**20%**
6. Perform repair procedures on control boxes and related components. a. Manufacturers' specifications b. Measurements c. Evaluation of component conditions d. Determine causes of component failure	**20%**

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Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Unit: H2 Hydraulic Systems

Level: Two

Duration: 35 hours

Theory: 20 hours

Practical: 15 hours

Overview:

This unit is designed to provide the apprentice with the relevant hydraulic systems knowledge for working with today's marine and outdoor power equipment. Beginning with an overview of terminology and concepts associated with charging systems, the unit covers the generation of electricity by the charging system and its components, the testing and servicing procedures, and the inspection and repair procedures for the charging system. Control boxes and hydraulic systems on both marine and outdoor power equipment have benefited from engineering enhancements. There is an increasing use of electronic operator controls, which allow for more operational control aimed at enhancing use and operator enjoyment of the unit.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology and concepts associated with hydraulic systems.	**10%**
2. Describe the operation and components of hydraulic systems. a. Closed loop b. Open loop	**10%**
3. Describe the basic hydraulic principles and theory. a. Pressure b. Force c. Area d. Volume e. Power f. Flow rate cycle times	**10%**
4. Interpret basic hydraulic schematics.	**10%**
5. Describe the testing and servicing procedures for hydraulic systems and their components. a. Sensory inspection b. Manufacturers' specifications c. Retrieval and interpretation of error codes	**10%**
6. Demonstrate mathematical calculations related to the basic hydraulic principles. a. Pressure	**10%**

b. Force
c. Area
d. Volume
e. Power
f. Flow rate cycle times

7. Perform inspection and evaluation of hydraulic systems. 20%

a. Measurements
   - Fluid levels
   - Hydraulic test
b. Evaluation of component conditions (e.g., chafed or broken hoses and leaks)
c. Determine causes of component failure

8. Perform repair procedures on charging and starting systems. 20%

a. Measurements
b. Manufacturers' specifications
c. Assemble, install and adjust components
d. Remove, disassemble and replace components (e.g., pumps, cylinders, valves)
e. Correct causes of component failure (e.g., chafed or broken hoses and leaks)

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