Apprenticeship Manitoba

Marine and Outdoor Power Equipment Technician

Manitoba

Rev. 01/10

ACKNOWLEDGEMENTS

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OTHER RELATED OCCUPATIONAL TITLES

In developing this analysis, the Industry Working Group (IWG) consulted National Occupational Analyses prepared by Human Resources Skills Development Canada from the following:

Agriculture Equipment Technician National Occupational Analysis	2007
Automotive Service Technician National Occupational Analysis	2005
Motorcycle Mechanic National Occupational Analysis	2006
Recreation Vehicle Service Technician National Occupational Analysis	2006
Transport Trailer Technician National Occupational Analysis	2008

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Appendices

GUIDE TO ANALYSIS
DEVELOPMENT OF ANALYSIS

A draft analysis is developed by a knowledgeable consultant who, with the assistance of a committee of experts in the field, identifies all the tasks performed in the occupation.

STRUCTURE OF ANALYSIS

To facilitate the understanding of the nature of the occupation, the work performed is divided into the following divisions:

A. BLOCK - is the largest division within the analysis and reflects a distinct operation relevant to the occupation.

B. TASK - is the distinct activity that, combined with others, makes up the logical and necessary steps the worker is required to perform to complete a specific assignment within a "BLOCK."

C. SUB-TASK - is the smallest division into which it is practical to subdivide any work activity and, combined with others, fully describes all duties constituting a "TASK."

Supporting Knowledge and Abilities
The element of skill and knowledge that an individual must acquire to adequately perform the task is identified under this heading.

Trends
Any shifts or changes in technology or the working environment which affect the block are identified under this heading.

VALIDATION METHOD

Several Marine and Outdoor Power Equipment Technicians validated the sub-tasks and applied percentage ratings to blocks and tasks. This method for the validation assisted in the completion of the time weighting section of the position description.

DEFINITIONS

YES: You perform this sub-task.

NO: You do **not** perform this sub-task.

BLOCK %: the percentage of time you spend on a monthly basis performing this component.

TASK %: the percentage of time you spend on a monthly basis performing this task.

TOOLS AND EQUIPMENT (APPENDIX "A")

ACRONYMS (APPENDIX "B")

PIE CHART (APPENDIX "C")

The graph depicts the percentages the Committee assigned to blocks in the analysis during validation.

DACUM CHART (APPENDIX “D”)

The listing of all the blocks, tasks and sub-tasks as established by the Industry Working Group and validated by several Marine and Outdoor Power Equipment Technicians.

SCOPE OF THE OCCUPATION

This occupational analysis identifies tasks performed by qualified Marine and Outdoor Power Equipment Technicians across Manitoba. Marine and Outdoor Power Equipment Technicians repair, service and maintain all small gasoline and diesel powered equipment such as outboard and inboard motors, jet drives in boats and personal watercraft (PWC), stern drives, lawn and garden equipment, snowmobiles, all-terrain vehicles (ATVs) and similar multi-wheeled vehicles, and related trailers.

In general, Marine and Outdoor Power Equipment Technicians perform the following main duties:

- Review and interpret work orders and technical manuals
- Inspect and test engine, motors and other mechanical components using test devices to diagnose and isolate faults
- Adjust, repair or replace mechanical, fuel, or electrical system parts and components using hand tools and equipment
- Test and adjust repaired equipment for proper performance
- Perform scheduled maintenance service on equipment
- Advise customers on work performed and general condition of equipment
- Estimate cost of repairs

Technicians are employed by a variety of employers in both private and public sectors in a number of different industries based on specialized equipment. Some employers may include equipment distributors, retailers, rental companies, parks and recreation (landscaping maintenance and builders, golf courses, forestry companies), and original equipment manufacturers (OEMs).

To be successful in the trade, technicians need a mechanical ability and an interest in all types of machinery and engines, electronics and precision equipment; customer relation skills, the ability to work alone or as part of a team; the ability to think logically and keep up with changes in technology; and the ability to work in awkward, tight or confined spaces in all types of weather conditions.

Experienced journeypersons may advance to supervisory positions, shop foreman, service manager, or instructor. Some technicians may open their own garage or marine and outdoor power equipment business. With additional training, technicians can transfer their skills and knowledge to related vehicles and equipment such as motorcycles and related products.

OCCUPATIONAL OBSERVATIONS

Outdoor power equipment, multi-wheeled vehicles, and marine products are increasingly using advanced electronic controls. The diagnosis and repair of these increasingly complex controls makes knowledge of electrical, electronic, and hydraulic systems essential to this trade.

With increasing interest in marine and outdoor power equipment comes consumer-driven design developments. Among these are the expanding availability and use of aftermarket and OEM accessories, which means that a technician in this trade must keep current with both component and accessory applications and installations.

There is concern regarding gasoline and diesel engine emissions produced by marine and outdoor power equipment. Changes to regulations and emission standards will have an impact on gasoline and diesel engine construction. These changes will also have an impact on the duties of technicians when they diagnose and repair these engines.

ANALYSIS

BLOCK A

Occupational Skills

Trends: *There are more efficient tools, methods of repair and more sophisticated diagnostic techniques. Workplaces have become safer and safety requirements have become more stringent. There is more access to trade information through new information technologies such as CD-ROMs and the Internet.*

Task 1 Uses tools and equipment.

Sub-task

1.01 Uses personal protective equipment (PPE) and safety equipment.

Supporting Knowledge and Abilities

1.01.01	knowledge of types of PPE such as masks, glasses, coveralls and hearing protection
1.01.02	knowledge of types of safety equipment such as fire extinguisher, eye wash station and workplace mats
1.01.03	knowledge of PPE and safety equipment operations
1.01.04	knowledge of location of PPE and safety equipment
1.01.05	knowledge of workplace safety and health regulations
1.01.06	ability to select PPE and safety equipment
1.01.07	ability to inspect and maintain PPE and safety equipment
1.01.08	ability to store PPE and safety equipment

Sub-task

1.02	**Uses hand tools.**	**Supporting Knowledge and Abilities**
	1.02.01	knowledge of types of hand tools
	1.02.02	knowledge of hand tool operating procedures
	1.02.03	knowledge of imperial and metric tool sizes
	1.02.04	ability to select hand tools
	1.02.05	ability to organize hand tools
	1.02.06	ability to maintain hand tools
	1.02.07	ability to recognize worn, damaged or defective hand tools
	1.02.08	ability to store hand tools

Sub-task

1.03	**Uses power tools.**	**Supporting Knowledge and Abilities**
	1.03.01	knowledge of types of power tools and specialty tools
	1.03.02	knowledge of power tool operating procedures
	1.03.03	ability to select power tools
	1.03.04	ability to organize power tools
	1.03.05	ability to maintain power tools
	1.03.06	ability to recognize worn, damaged or defective power tools
	1.03.07	ability to store power tools

Sub-task

1.04	**Uses and tests diagnostic tools.**	**Supporting Knowledge and Abilities**
	1.04.01	knowledge of types of diagnostic and testing tools such as multimeters, compression gauges, vacuum gauges and computers
	1.04.02	knowledge of interpreting results from diagnostic and testing equipment
	1.04.03	knowledge of operating procedures
	1.04.04	knowledge of accuracy of testing devices
	1.04.05	ability to select diagnostic and testing tools
	1.04.06	ability to calibrate diagnostic and testing tools
	1.04.07	ability to interpret readings
	1.04.08	ability to perform calculations
	1.04.09	ability to convert between imperial and metric
	1.04.10	ability to maintain diagnostic and testing tools
	1.04.11	ability to store diagnostic and testing tools

Sub-task

1.05	**Uses cutting and heating tools and equipment.**	**Supporting Knowledge and Abilities**
	1.05.01	knowledge of types of cutting and heating tools and equipment such as gas and electric
	1.05.02	knowledge of materials to be cut or heated
	1.05.03	knowledge of cutting and heating consumable materials such as propane, oxygen and acetylene

1.05.04	knowledge of cutting and heating tools and equipment operating procedures
1.05.05	knowledge of ventilation requirements
1.05.06	ability to select cutting and heating tools and equipment
1.05.07	ability to perform cutting and heating procedures
1.05.08	ability to maintain cutting and heating tools and equipment
1.05.09	ability to recognize flammable materials
1.05.10	ability to identify unsafe cutting and heating equipment
1.05.11	ability to store cutting and heating equipment

Sub-task

1.06 Uses hoisting, lifting and securing equipment.

Supporting Knowledge and Abilities

1.06.01	knowledge of types of lifting equipment such as jacks, hoists and stands
1.06.02	knowledge of limitations of hoisting, lifting and securing equipment
1.06.03	knowledge of types of moving equipment such as front end loaders, forklifts and dollies
1.06.04	knowledge of purposes, styles and operation of lifting and moving equipment
1.06.05	ability to follow manufacturers' instructions for use, maintenance and storage
1.06.06	ability to select lifting points
1.06.07	ability to select lifting and moving equipment

Sub-task

1.07	**Uses measuring tools.**	**Supporting Knowledge and Abilities**
	1.07.01	knowledge of types of measuring tools such as micrometers, dial indicators, calipers, telescopic gauges and feeler gauges
	1.07.02	knowledge of operating procedures
	1.07.03	knowledge of types of measurements such as volume, diameter, linear and pressure
	1.07.04	ability to select measuring tools
	1.07.05	ability to calibrate measuring tools
	1.07.06	ability to interpret readings
	1.07.07	ability to organize measuring tools
	1.07.08	ability to maintain measuring tools
	1.07.09	ability to perform calculations
	1.07.10	ability to convert between imperial and metric
	1.07.11	ability to store measuring tools

Task 2 Organizes work.

Sub-task

2.01	**Uses documentation and reference tools.**	**Supporting Knowledge and Abilities**
	2.01.01	knowledge of types of documentation such as service manuals, parts manuals, service bulletins and work orders
	2.01.02	knowledge of formats of documentation and reference tools such as print, Internet, microfiche and CD-ROM
	2.01.03	knowledge of Workplace Hazardous Materials Information System (WHMIS) documentation and symbols

2.01.04 ability to interpret and extract specific information

2.01.05 ability to interpret technical sketches such as the routing of hoses, wires and cables

2.01.06 ability to complete work-related records such as work orders and service reports

2.01.07 ability to record technical information such as warranty claims and failure service analysis

Sub-task

2.02 Communicates with others.

Supporting Knowledge and Abilities

2.02.01 knowledge of trade terminology

2.02.02 knowledge of verbal and written communication

2.02.03 ability to explain technical information in layperson's terms

2.02.04 ability to acquire information through questioning

2.02.05 ability to use communication equipment

2.02.06 ability to communicate with customers, manufacturers, suppliers and supervisors

2.02.07 ability to consult with colleagues

2.02.08 ability to communicate with other tradespeople such as welders, machinists and motor vehicle body repairers

2.02.09 ability to consult with authorities such as insurance appraisers and safety inspectors

2.02.10 ability to resolve customer complaints

Sub-task

2.03	**Plans daily tasks.**	**Supporting Knowledge and Abilities**
	2.03.01	knowledge of time management
	2.03.02	knowledge of sequencing of jobs
	2.03.03	ability to assign priorities to tasks
	2.03.04	ability to estimate repair times and finish dates
	2.03.05	ability to plan required materials and tools for diagnostics and repair for service calls
	2.03.06	ability to organize schedule

Task 3 **Performs routine trade activities.**

Sub-task

3.01	**Maintains safe work environment.**	**Supporting Knowledge and Abilities**
	3.01.01	knowledge of WHMIS
	3.01.02	knowledge of workers' rights and responsibilities
	3.01.03	knowledge of company safety policies and procedures
	3.01.04	knowledge of safety training requirements
	3.01.05	knowledge of jurisdictional health and safety acts and regulations
	3.01.06	knowledge of emergency procedures
	3.01.07	knowledge of on-site first aid stations
	3.01.08	knowledge of disposal and recycling procedures
	3.01.09	ability to apply WHMIS procedures
	3.01.10	ability to interpret safety and environmental regulations
	3.01.11	ability to recognize and prevent personal injury hazards

Sub-task

3.02 Uses fasteners, sealants, adhesives and gaskets.

Supporting Knowledge and Abilities

3.02.01	knowledge of types and applications of fasteners such as locking washers, lock nuts and split washers
3.02.02	knowledge of types and applications of sealing devices, adhesives and gaskets
3.02.03	knowledge of torque specification of fasteners
3.02.04	knowledge of taps, dies and thread repair kits
3.02.05	knowledge of anaerobic locking materials and their applications
3.02.06	ability to select the appropriate sealing or gasket material for the job
3.02.07	ability to install fasteners, sealing devices, adhesives and gaskets
3.02.08	ability to identify grade, thread pitch and size of fasteners
3.02.09	ability to make gaskets
3.02.10	ability to repair threads using tools such as taps, dies, chasers and thread inserts
3.02.11	ability to apply specialty sealants such as aerobic and anaerobic
3.02.12	ability to remove broken fasteners

Sub-task

3.03 Cleans parts and components.

Supporting Knowledge and Abilities

3.03.01	knowledge of types of cleaning agents
3.03.02	knowledge of effects of cleaning agents on different types of surfaces

3.03.03 knowledge of handling, storage and disposal requirements for cleaning agents

3.03.04 knowledge of ventilation requirements

3.03.05 ability to select cleaning agent required for specific application

3.03.06 ability to apply cleaning procedures

3.03.07 ability to use cleaning equipment such as parts washers and pressure washers

Sub-task

3.04 Lubricates parts and components.

Supporting Knowledge and Abilities

3.04.01 knowledge of types of lubricants

3.04.02 knowledge of locations of lubrication points

3.04.03 ability to select lubricant required for specific application

3.04.04 ability to inspect components prior to lubricating

3.04.05 ability to use lubricating equipment such as grease guns, auto-lube systems and oil delivery systems

Sub-task

3.05 Maintains fluids and lubricants.

Supporting Knowledge and Abilities

3.05.01 knowledge of types of fluids such as oil, methyl hydrate and fuel

3.05.02 knowledge of types of lubricants such as synthetic, semi-synthetic and non-synthetic

3.05.03 knowledge of disposal and recycling of fluids

3.05.04	knowledge of fluid and lubricant properties
3.05.05	ability to perform sensory inspections of fluids and lubricants
3.05.06	ability to verify fluid levels such as hub oil, hydraulic and coolants
3.05.07	ability to identify and select types and grades of fluids and lubricants appropriate for the application
3.05.08	ability to store and dispose of fluids and lubricants according to regulations

Sub-task

3.06 Maintains bearings/bushings and seals.

Supporting Knowledge and Abilities

3.06.01	knowledge of types of bearings/bushings
3.06.02	knowledge of seals such as static and dynamic
3.06.03	knowledge of the application of bearings/bushings and seals
3.06.04	ability to install wear sleeves
3.06.05	ability to recognize worn, damaged and defective bearings/bushings, seals and shafts
3.06.06	ability to lubricate bearings/bushings and seals
3.06.07	ability to install bearings/bushings and seals
3.06.08	ability to identify the allowable tolerance of bearings/bushings
3.06.09	ability to adjust bearings/bushings

Sub-task

3.07	**Verifies equipment installations and repairs.**	**Supporting Knowledge and Abilities**
	3.07.01	knowledge of company policies and procedures such as work orders and checklists
	3.07.02	knowledge of repair performed
	3.07.03	knowledge of original complaint
	3.07.04	ability to bench test rebuilt components such as starters, gear boxes and injectors
	3.07.05	ability to perform sensory inspections
	3.07.06	ability to advise operator of required follow-up procedures such as re-torques, fluid top-ups and break-in periods
	3.07.07	ability to install and repair non-OEM equipment
	3.07.08	ability to remove and replace components
	3.07.09	ability to verify that installations/ dimensions/pressures are correct according to OEM specifications

BLOCK B

Engine and Engine Support Systems

Trends: *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.*

Task 4 Performs engine diagnostics.

Sub-task

4.01 Diagnoses two-stroke engines.

Supporting Knowledge and Abilities

4.01.01	knowledge of types of cylinder heads such as air and liquid-cooled
4.01.02	knowledge of cylinder head components such as decompressor and spark plugs
4.01.03	knowledge of cylinder head operation
4.01.04	knowledge of manufacturers' service specifications
4.01.05	knowledge of diagnostic procedures
4.01.06	knowledge of types of valve systems such as reed valve, rotary valve and piston port
4.01.07	knowledge of valve system operation
4.01.08	knowledge of types of cylinder materials such as cast iron and plated
4.01.09	knowledge of types of pistons such as cast and forged
4.01.10	knowledge of cylinder and piston components such as wrist pins, circlips and rings
4.01.11	knowledge of cylinder and piston operation
4.01.12	knowledge of types of crankshaft assemblies such as single and multi-cylinder

	4.01.13	knowledge of crankshaft assembly components such as connecting rods, labyrinth seals, flywheels, thrust washers and wrist pin bearings
	4.01.14	knowledge of function of multi-cylinder crank seals
	4.01.15	knowledge of crankshaft assembly operation
	4.01.16	knowledge of engine case operation
	4.01.17	knowledge of types of cooling systems such as liquid and air-cooled
	4.01.18	knowledge of cooling system components such as pumps, lines, radiators, cooling fins and thermostats
	4.01.19	knowledge of cooling system operation
	4.01.20	ability to perform checks and measurements such as valve timing, valve operation and port timing
	4.01.21	ability to perform checks and measurements such as indexing of multi-throw crank, pressure check, end play and bearing clearances
	4.01.22	ability to evaluate component conditions such as deterioration and leaks
	4.01.23	ability to identify causes of failure

Sub-task

4.02 Diagnoses four-stroke engines.	**<u>Supporting Knowledge and Abilities</u>**
4.02.01	knowledge of types of cylinder heads such as air or liquid-cooled, and single or multi-valve
4.02.02	knowledge of cylinder head components such as valves, guides and seals
4.02.03	knowledge of cylinder head operation
4.02.04	knowledge of manufacturers' service limits

4.02.05	knowledge of diagnostic procedures
4.02.06	knowledge of types of valve trains such as overhead cam, push rod and desmodromic
4.02.07	knowledge of valve train components such as sprockets, gears, cams, rockers, chains and belts
4.02.08	knowledge of valve train operation
4.02.09	knowledge of piston components such as wrist pins, circlips and rings
4.02.10	knowledge of types of cylinder materials such as cast iron and plated
4.02.11	knowledge of cylinder and piston operation
4.02.12	knowledge of types of crankshaft assemblies such as roller, plain bearing (shell bearing), forged and pressed
4.02.13	knowledge of crankshaft assembly components such as connecting rods, labyrinth seals, flywheels and thrust washers
4.02.14	knowledge of types of counterbalance assemblies such as gear or chain driven, and single or multi-counterweights
4.02.15	knowledge of counterbalance operation
4.02.16	knowledge of types of engine cases such as single or multi-cylinder and vertical or horizontal split
4.02.17	knowledge of engine case components such as bearing bosses, covers and fasteners
4.02.18	knowledge of types of cooling systems such as air and liquid (oil, coolant) cooled
4.02.19	knowledge of cooling system components such as pumps, lines, radiators, cooling fins and thermostats
4.02.20	knowledge of cooling system operation
4.02.21	ability to perform sensory inspection

4.02.22	ability to evaluate component conditions such as cracking, warpage and leaks
4.02.23	ability to perform checks and measurements such as spring pressure, valve stem wear and valve sealing
4.02.24	ability to determine causes of failure
4.02.25	ability to perform checks and measurements such as valve timing, valve lash, chain wear, gear wear and clearances
4.02.26	ability to evaluate component conditions such as structural integrity, leaks and wear

Task 5 Repairs engines and engine support systems.

Sub-task

5.01 Repairs two-stroke engines.

Supporting Knowledge and Abilities

5.01.01	knowledge of types of cylinder heads such as air or liquid-cooled
5.01.02	knowledge of cylinder head components such as decompressor and spark plugs
5.01.03	knowledge of cylinder head operation
5.01.04	knowledge of manufacturers' service limits and procedures
5.01.05	knowledge of types of valve systems such as reed valve, rotary valve and piston port
5.01.06	knowledge of valve system components such as reeds, rotary valves and power valve actuators
5.01.07	knowledge of valve system operation
5.01.08	knowledge of types of cylinder materials such as cast iron and plated
5.01.09	knowledge of types of pistons such as cast and forged
5.01.10	knowledge of cylinder and piston operation

5.01.11	knowledge of types of crankshaft assemblies such as single and multi-cylinder
5.01.12	knowledge of crankshaft assembly components such as connecting rods, labyrinth seals, flywheels, thrust washers and wrist pin bearings
5.01.13	knowledge of crankshaft operation
5.01.14	knowledge of types of engine cases such as single or multi-cylinder, and vertical or horizontal split
5.01.15	knowledge of engine case components such as bearing bosses, covers, case seals and fasteners
5.01.16	knowledge of engine case operation
5.01.17	knowledge of types of cooling systems such as liquid and air-cooled
5.01.18	knowledge of cooling system components such as pumps, lines, radiators, cooling fins and thermostats
5.01.19	knowledge of cooling system operation
5.01.20	ability to remove and replace components
5.01.21	ability to perform reconditioning such as decarbonization and machining
5.01.22	ability to correct causes of failure
5.01.23	ability to set tolerances within manufacturers' specifications
5.01.24	ability to perform reconditioning such as boring, honing and chamfering

Sub-task

5.02 Repairs four-stroke engines.

Supporting Knowledge and Abilities

5.02.01	knowledge of types of cylinder heads such as air or liquid-cooled, and single or multi-valve
5.02.02	knowledge of cylinder head components such as valves, guides and seals

5.02.03	knowledge of cylinder head operation
5.02.04	knowledge of manufacturers' service limits and procedures
5.02.05	knowledge of types of valve trains such as overhead cam, push rod and desmodromic
5.02.06	knowledge of valve train components such as sprockets, gears, cams, rockers, chains and belts
5.02.07	knowledge of valve train operation
5.02.08	knowledge of types of cylinders such as air and liquid cooled
5.02.09	knowledge of piston components such as wrist pins, circlips and rings
5.02.10	knowledge of types of cylinder materials such as cast iron and plated
5.02.11	knowledge of types of pistons such as cast and forged
5.02.12	knowledge of cylinder and piston operation
5.02.13	knowledge of types of crankshaft assemblies such as roller, plain bearing (shell bearing), forged and pressed
5.02.14	knowledge of crankshaft assembly components such as connecting rods, flywheels and thrust washers
5.02.15	knowledge of crankshaft assembly operation
5.02.16	knowledge of types of counterbalance assemblies such as gear or chain driven, and single or multi-counterweights
5.02.17	knowledge of counterbalance assembly components such as gears, chains and bearings
5.02.18	knowledge of counterbalance operation
5.02.19	knowledge of types of engine cases such as single or multi-cylinder and vertical or horizontal split

5.02.20	knowledge of engine case components such as bearing bosses, covers and fasteners
5.02.21	knowledge of engine case operation
5.02.22	knowledge of types of cooling systems such as air and liquid-cooled
5.02.23	knowledge of cooling system components such as pumps, lines, radiators, cooling fins and thermostat
5.02.24	knowledge of cooling system operation
5.02.25	ability to remove and replace components
5.02.26	ability to recondition components such as valves, seats and guides
5.02.27	ability to correct causes of failure
5.02.28	ability to set tolerances within manufacturers' specifications
5.02.29	ability to recondition components such as rocker arms and valves
5.02.30	ability to perform reconditioning such as reboring, sleeving and honing

BLOCK C

Drivetrains

Trends: *Drivetrains on both marine and outdoor power equipment have benefited from engineering enhancements, from improved piston design to the use of new lighter-weight components using carbon fiber. Increasingly, units come standard with digital operator controls and digital throttle and shift (DTS).*

Task 6 Diagnoses clutches and primary drive systems.

Sub-task

6.01 Diagnoses automatic clutches.

Supporting Knowledge and Abilities

6.01.01	knowledge of types of automatic clutches such as centrifugal, fluid and movable sheave
6.01.02	knowledge of automatic clutch components such as shoes, drums and springs
6.01.03	knowledge of automatic clutch operation
6.02.04	knowledge of manufacturers' specifications
6.02.05	knowledge of diagnostic procedures
6.02.06	ability to perform sensory inspection
6.02.07	ability to evaluate component conditions such as burnt materials, broken springs and wear
6.02.08	ability to perform checks and measurements
6.02.09	ability to determine causes of failure

Sub-task

6.02	**Diagnoses manual-start systems.**	**Supporting Knowledge and Abilities**
	6.02.01	knowledge of components such as manual start component, ratcheting gear and spring, and sheath and rope
	6.02.02	knowledge of manual start operation
	6.02.03	knowledge of diagnostic procedures
	6.02.04	ability to perform sensory inspection
	6.02.05	ability to evaluate component conditions
	6.02.06	ability to check damage to component such as shaft, bushings and gears
	6.02.07	ability to determine causes of failure

Sub-task

6.03	**Diagnoses primary drive belts, pulleys and chains.**	**Supporting Knowledge and Abilities**
	6.03.01	knowledge of types of primary drives, chain and sprocket, and belt and pulley systems
	6.03.02	knowledge of primary drive chain and sprocket system operation
	6.03.03	knowledge of components such as chain tensioners and sliders
	6.03.04	knowledge of manufacturers' specifications
	6.03.05	knowledge of diagnostic procedures
	6.03.06	ability to perform sensory inspections
	6.03.07	ability to evaluate component conditions such as sprocket wear, stretched chains, roller defects and belt wear
	6.03.08	ability to identify causes of failure

Sub-task

6.04	**Diagnoses manual clutches.**	**Supporting Knowledge and Abilities**
	6.04.01	knowledge of types of manual clutches such as wet and dry
	6.04.02	knowledge of manual clutch components such as springs, fibre plates and metal plates
	6.04.03	knowledge of types of release mechanisms such as hydraulic, ramp and cable lever
	6.04.04	knowledge of manual clutch operation
	6.04.05	knowledge of manufacturers' specifications
	6.04.06	knowledge of diagnostic procedures
	6.04.07	ability to perform sensory inspection
	6.04.08	ability to evaluate component conditions such as burnt, broken and worn
	6.04.09	ability to perform checks and measurements such as plate thickness and warpage
	6.04.10	ability to determine causes of failure

Task 7 Repairs clutches and primary drives.

Sub-task

7.01	**Repairs automatic clutches.**	**Supporting Knowledge and Abilities**
	7.01.01	knowledge of types of automatic clutches such as centrifugal, fluid and movable sheave
	7.01.02	knowledge of automatic clutch components such as shoes, drums and springs
	7.01.03	knowledge of automatic clutch operation

7.01.04	knowledge of manufacturers' specifications
7.01.05	ability to remove and replace components
7.01.06	ability to correct causes of failure such as lack of lubrication and incorrect adjustment

Sub-task

7.02 Repairs manual-start systems.

Supporting Knowledge and Abilities

7.02.01	knowledge of manual start components such as shaft, ratcheting gear and spring
7.02.02	knowledge of manual start operation
7.02.03	knowledge of manufacturers' specifications
7.02.04	ability to remove and replace components
7.02.05	ability to perform adjustments such as spring tension and decompression cable adjustment
7.02.06	ability to correct causes of failure

Sub-task

7.03 Repairs primary drive belts, pulleys and chains.

Supporting Knowledge and Abilities

7.03.01	knowledge of types of primary drives, chain and sprocket, and belt and pulley systems
7.03.02	knowledge of components such as chain tensioners and sliders
7.03.03	knowledge of manufacturers' specifications
7.03.04	knowledge of component failures such as breakage, damage and normal wear
7.03.05	ability to remove, replace and adjust components such as chains, belts, tensioners and sprockets within manufacturers' specifications

7.03.06	ability to correct causes of failure such as lack of lubrication and incorrect adjustment

Sub-task

7.04 Repairs manual clutches. **<u>Supporting Knowledge and Abilities</u>**

7.04.01	knowledge of types of manual clutches such as wet and dry
7.04.02	knowledge of manual clutch components such as springs, fibre plates and metal plates
7.04.03	knowledge of types of release mechanisms such as hydraulic, ramp and cable lever
7.04.04	knowledge of manual clutch operation
7.04.05	knowledge of manufacturers' specifications
7.04.06	ability to remove and replace components
7.04.07	ability to measure thickness of clutch plates
7.04.18	ability to correct causes of failure

Task 8 Diagnoses transmissions.

Sub-task

8.01 Diagnoses constant mesh systems. **<u>Supporting Knowledge and Abilities</u>**

8.01.01	knowledge of constant mesh transmission components such as shifter mechanisms, gears and shafts
8.01.02	knowledge of operation of constant mesh transmissions
8.01.03	knowledge of diagnostic procedures
8.01.04	ability to perform sensory inspection

8.01.05 ability to evaluate component conditions such as worn gears and bearings, and damaged shift forks

8.01.06 ability to perform measurements such as shaft end play, gear shimming and fork clearance

8.01.07 ability to determine causes of component or function failure

Sub-task

8.02 Diagnoses variable-ratio belt transmissions.

Supporting Knowledge and Abilities

8.02.01 knowledge of variable ratio belt transmission components such as v-belt, springs, rollers and sheaves

8.02.02 knowledge of variable ratio belt transmission operation

8.02.03 knowledge of manufacturers' specifications

8.02.04 knowledge of diagnostic procedures

8.02.05 ability to perform sensory inspection

8.02.06 ability to evaluate component conditions such as sticking sheaves, belt wear and sheave face grooving

8.02.07 ability to perform measurements such as belt width and spring free length

8.02.08 ability to determine causes of failure such as lack of maintenance and oil seal leak

Sub-task

8.03 Diagnoses automatic and fluid-drive transmissions.

Supporting Knowledge and Abilities

8.03.01 knowledge of types of automatic transmissions such as fluid drive and torque converter

8.03.02 knowledge of automatic transmission components such as drive pump, driven motor and pistons

8.03.03	knowledge of types of fluids used
8.03.04	knowledge of operation of automatic transmissions
8.03.05	knowledge of manufacturers' specifications
8.03.06	knowledge of diagnostic procedures
8.03.07	knowledge of transmission cooling systems
8.03.08	knowledge of control systems
8.03.09	ability to perform sensory inspection
8.03.10	ability to evaluate component conditions such as pump wear and fluid deterioration
8.03.11	ability to perform measurements such as oil pressure and flow
8.03.12	ability to perform hydraulic pressure test
8.03.13	ability to test transmission cooler operation and transmission lines
8.03.14	ability to check fluid levels and condition
8.03.15	ability to check for leaks, inspect for damage and test components
8.03.16	ability to use specialty tools such as scan tools, pressure gauges and stethoscopes
8.03.17	ability to follow fluid flow charts
8.03.18	ability to determine causes of failure such as lack of maintenance and contamination

Task 9 Repairs transmissions.

Sub-task

9.01 Repairs constant mesh systems.

Supporting Knowledge and Abilities

9.01.01	knowledge of constant mesh transmission components such as shifter mechanisms, gears and shafts
9.01.02	knowledge of operation of constant mesh transmissions
9.01.03	knowledge of manufacturers' specifications
9.01.04	ability to remove and replace components
9.01.05	ability to perform measurements such as shift fork clearance and shifter pawl adjustment
9.01.06	ability to correct causes of failure such as improper clutch adjustment, lack of lubrication and improper adjustment of final drive

Sub-task

9.02 Repairs variable-ratio belt transmissions.

Supporting Knowledge and Abilities

9.02.01	knowledge of variable ratio belt transmission components such as v-belt, springs, rollers and sheaves
9.02.02	knowledge of variable ratio belt transmission operation
9.02.03	knowledge of manufacturers' specifications
9.02.04	ability to remove and replace components
9.02.05	ability to deglaze sheave faces
9.02.06	ability to adjust sheave plate spacing
9.02.07	ability to correct causes of failure

Sub-task

9.03	**Repairs automatic and fluid-drive transmissions.**	**Supporting Knowledge and Abilities**
	9.03.01	knowledge of automatic transmission components such as shifter mechanisms, gears and shafts
	9.03.02	knowledge of manufacturers' specifications
	9.03.03	knowledge of control systems
	9.03.04	ability to remove and replace components
	9.03.05	ability to maintain a dust-free work environment
	9.03.06	ability to remove, replace or recondition assemblies
	9.03.07	ability to use specialized tools such as pullers, compressors, installers, scan tool and DVOM
	9.03.08	ability to perform adjustments and measurements
	9.03.09	ability to replace electronic components such as solenoids, wiring and sensors
	9.03.10	ability to correct causes of failure such as oil contamination and improper fluids

Task 10 Diagnoses final drives.

Sub-task

10.01 Diagnoses final drive shafts and gears.

Supporting Knowledge and Abilities

10.01.01	knowledge of final drive shaft and gear components such as universal joints, bearings and seals
10.01.02	knowledge of operation of final drive shaft and gears
10.01.03	knowledge of manufacturers' specifications
10.01.04	knowledge of diagnostic procedures
10.01.05	ability to perform sensory inspection
10.01.06	ability to evaluate component conditions such as worn oil seal, chipped or cracked gears and worn bearings
10.01.07	ability to measure backlash of gear
10.01.08	ability to determine causes of failure such as leaking oil seal and incorrect lubricant

Sub-task

10.02 Diagnoses final drive chains, sprockets, belts and pulleys.

Supporting Knowledge and Abilities

10.02.01	knowledge of components such as belts and sprockets/pulleys
10.02.02	knowledge of final drive sprocket/pulley ratios
10.02.03	knowledge of operation of final drive belts and sprockets/pulleys
10.02.04	knowledge of manufacturers' specifications
10.02.05	ability to perform sensory inspection

10.02.06 ability to evaluate component conditions such as wear of sprockets/pulleys and wear of belts

10.02.07 ability to determine causes of failure

Task 11 Repairs final drives.

Sub-task

11.01 Repairs final drive shafts and gears.

Supporting Knowledge and Abilities

11.01.01 knowledge of final drive shaft and gear components such as universal joints, bearings and seals

11.01.02 knowledge of operation of final drive shaft and gears

11.01.03 knowledge of manufacturers' specifications

11.01.04 ability to remove and replace components

11.01.05 ability to shim gear lash

11.01.06 ability to correct causes of failure such as leaking oil seal and incorrect lubricant

Sub-task

11.02 Repairs final drive chains sprockets, belts and pulleys.

Supporting Knowledge and Abilities

11.02.01 knowledge of types of chains such as roller chain with seals and roller chain without seals

11.02.02 knowledge of operation of final drive chains and sprockets

11.02.03 knowledge of final drive ratio

11.02.04 knowledge of manufacturers' specifications

11.02.05	knowledge of components such as belts and sprockets/pulleys
11.02.06	knowledge of operation of belt and sprocket/pulley drive
11.02.07	knowledge of drive sprocket/pulley ratios
11.02.08	ability to remove and replace components
11.02.09	ability to perform chain adjustment
11.02.10	ability to adjust belt tension
11.02.11	ability to check alignment of sprockets/ pulleys
11.02.12	ability to correct causes of failure such as overtightening, lack of lubrication and misalignment

BLOCK D

Chassis, Steering, Suspension, Brakes and Tires

Trends: *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.*

Task 12 Diagnoses chassis and steering systems.

Sub-task

12.01 Diagnoses frames and structural components.

Supporting Knowledge and Abilities

12.01.01	knowledge of types of frames and structures such as cradle, backbone, stamped and perimeter frames
12.01.02	knowledge of frame materials such as aluminum, steel, fiberglass and composites
12.01.03	knowledge of steering geometry
12.01.04	knowledge of manufacturers' specifications
12.01.05	ability to perform sensory inspection
12.01.06	ability to evaluate component condition
12.01.07	ability to perform checks and measurements such as visual checks, alignment checks and pressure tests
12.01.08	ability to select and use diagnostic tools and equipment such as tape measures, levels and squares
12.01.09	ability to visually inspect to identify common defects such as cracks, fatigue, loose fasteners and oxidation
12.01.10	ability to determine causes of failure such as impact and stress

Sub-task

12.02	**Diagnoses manual steering systems.**	**Supporting Knowledge and Abilities**
	12.02.01	knowledge of types of steering heads such as telelever, triple clamp and cable type
	12.02.02	knowledge of steering head system components such as shafts, bearings, seals, cables and pulleys
	12.02.03	knowledge of steering geometry
	12.02.04	knowledge of system operation
	12.02.05	knowledge of manufacturers' specifications
	12.02.06	knowledge of diagnostic procedures
	12.02.07	ability to perform sensory inspection
	12.02.08	ability to check adjustment and measure preload
	12.02.09	ability to determine causes of failure such as stress, water damage and shock load

Sub-task

12.03	**Diagnoses electronic and hydraulic steering systems.**	**Supporting Knowledge and Abilities**
	12.03.01	knowledge of types of steering such as electronic and hydraulic
	12.03.02	knowledge of hydraulic steering components such as discs, seals, fluids and valves
	12.03.03	knowledge of electronic steering components such as motors, switches, relays and sensors
	12.03.04	knowledge of system operation
	12.03.05	knowledge of manufacturers' specifications
	12.03.06	knowledge of diagnostic procedures

12.03.07	ability to perform sensory inspection
12.03.08	ability to evaluate component conditions such as seal leakage, excessive play and binding
12.03.09	ability to determine the causes of failure such as leakage, physical damage, and electronic failure

Task 13 Repairs chassis and steering systems.

Sub-task

13.01 Repairs frames and structural components.

Supporting Knowledge and Abilities

13.01.01	knowledge of types of frames and structures such as cradle, backbone, stamped and perimeter frames, bumpers, safety chains, and couplers
13.01.02	knowledge of frame materials such as aluminum, steel, fiberglass, and composites
13.01.03	knowledge of steering geometry
13.01.04	ability to remove and replace bearings, races, bushings and seals
13.01.05	ability to grease bearings, races, bushings and seals
13.01.06	ability to set tolerances within manufacturers' specifications

Sub-task

13.02 Repairs manual steering systems.

Supporting Knowledge and Abilities

13.02.01	knowledge of types of steering heads such as telelever, triple clamp and cable type
13.02.02	knowledge of steering head system components such as shafts, bearings, seals, cables and pulleys

	13.02.03	knowledge of materials such as brass, steel and aluminum
	13.02.04	knowledge of steering geometry
	13.02.05	knowledge of system operation
	13.02.06	knowledge of manufacturers' specifications
	13.02.07	ability to remove and replace shafts, bearings, seals, cables and pulleys
	13.02.08	ability to grease shafts, bearings, seals, cables and pulleys
	13.02.09	ability to set tolerances within manufacturers' specifications

Sub-task

13.03	**Repairs electronic and hydraulic steering systems.**	**<u>Supporting Knowledge and Abilities</u>**
	13.03.01	knowledge of types of steering such as electronic and hydraulic
	13.03.02	knowledge of hydraulic steering components such as discs, seals, fluids and valves
	13.03.03	knowledge of electronic steering components such as motors, switches, relays and sensors
	13.03.04	knowledge of system operation
	13.03.05	knowledge of manufacturers' specifications
	13.03.06	ability to remove and replace components
	13.03.07	ability to set tolerances within manufacturers' specifications

Task 14 Diagnoses suspensions.

Sub-task

14.01 Diagnoses front suspensions.

Supporting Knowledge and Abilities

14.01.01	knowledge of front suspension systems such as telelever, telescopic (conventional and cartridge), A-arm, trailing arm, coil and leaf spring types
14.01.02	knowledge of front suspension system components such as air fittings, bushings, seals, springs, valves and shocks
14.01.03	knowledge of materials such as copper, brass, plastic, aluminum, steel and composites
14.01.04	knowledge of steering geometry
14.01.05	knowledge of system operation
14.01.06	knowledge of manufacturers' specifications
14.01.07	knowledge of diagnostic procedures
14.01.08	ability to perform sensory inspection
14.01.09	ability to evaluate component conditions such as bent, seized, leaking, binding and cracking
14.01.10	ability to perform checks and measurements such as fluid levels, spring sag, excessive play and steering geometry (rake, trail, offset)
14.01.11	ability to determine the causes of failure

Sub-task

14.02 Diagnoses rear suspensions.

Supporting Knowledge and Abilities

14.02.01	knowledge of types of rear suspension system such as single shock, twin shock, air shock, gas charged and hydraulic
14.02.02	knowledge rear suspension system components such as linkages, seals, bladders and springs

14.02.03	knowledge of materials such as copper, brass, steel, plastic, aluminum and composites
14.02.04	knowledge of system operation
14.02.05	knowledge of manufacturers' specifications
14.02.06	knowledge of diagnostic procedures
14.02.07	ability to perform sensory inspection
14.02.08	ability to evaluate component conditions such as bent, seized, leaking, binding and cracked
14.02.09	ability to perform checks and measurements such as excessive play, fluid levels and pressure
14.02.10	ability to determine the causes of failure

Sub-task

14.03 Diagnoses wheel/tracks and undercarriages.

Supporting Knowledge and Abilities

14.03.01	knowledge of wheels/tracks and undercarria theory and operating principles
14.03.02	knowledge of wheels components such as bias tires, radial tires and rims
14.03.03	knowledge of track and undercarriage components such as rubber tracks, support wheels and tensioning systems
14.03.04	knowledge of wheels/tracks and undercarriage component failures
14.03.05	knowledge of allowable tolerances according to OEM specifications
14.03.06	ability to select and use diagnostic tools and equipment such as pressure gauges and tape measures
14.03.07	ability to perform sensory inspections
14.03.08	ability to determine the causes of failure

Task 15 Repairs suspensions.

Sub-task

15.01 Repairs front suspensions.

Supporting Knowledge and Abilities

15.01.01	knowledge of front suspension systems such as telelever, telescopic (conventional and cartridge), A-arm, trailing arm, coil and leaf spring types
15.01.02	knowledge of front suspension system components such as air fittings, bushings, seals, springs, valves and shocks
15.01.03	knowledge of materials such as copper, brass, plastic, aluminum, steel and composites
15.01.04	knowledge of steering geometry
15.01.05	knowledge of system operation
15.01.06	knowledge of manufacturers' specifications
15.01.07	ability to remove and replace components such as seals, bushings, shocks, springs and fluids
15.01.08	ability to rebuild shocks and components
15.01.09	ability to set tolerances within manufacturers' specifications

Sub-task

15.02 Repairs rear suspensions.

Supporting Knowledge and Abilities

15.02.01	knowledge of types of rear suspension systems such as single shock, twin shock, air shock, gas charged and hydraulic
15.02.02	knowledge of rear suspension system components such as linkages, seals, bladders and springs
15.02.03	knowledge of materials such as copper, brass, plastic, aluminum, steel and composites
15.02.04	knowledge of system operation

15.02.05	knowledge of manufacturers' specifications
15.02.06	ability to remove and replace components such as seals, bushings, shafts, bladders and shocks
15.02.07	ability to rebuild shocks and components
15.02.08	ability to set tolerances within manufacturers' specifications

Sub-task

15.03 Repairs wheel/tracks and undercarriages.

Supporting Knowledge and Abilities

15.03.01	knowledge of wheels/tracks and undercarriage theory and operating principles
15.03.02	knowledge of wheels components such as bias tires, radial tires and rims
15.03.03	knowledge of track and undercarriage components such as rubber tracks, support wheels and tensioning systems
15.03.04	knowledge of allowable tolerances according to OEM specifications
15.03.05	ability to remove wheel components
15.03.06	ability to remove and disassemble tracks and undercarriages components
15.03.07	ability to determine service limits
15.03.08	ability to replace worn and damaged components such as fasteners, idlers, pins and bushings
15.03.09	ability to repair components such as tensioning devices, idlers and rims
15.03.10	ability to align tensioning idlers on track systems
15.03.11	ability to assemble and install components according to OEM specifications
15.03.12	ability to adjust wheel track width

Task 16 Diagnoses braking systems.

Sub-task

16.01 Diagnoses hydraulic braking systems	**Supporting Knowledge and Abilities**	
	16.01.01	knowledge of hydraulic principles
	16.01.02	knowledge of types of hydraulic braking systems such as disc and drum
	16.01.03	knowledge of components such as master cylinder, brake line, caliper (slave cylinder), brake pads and fluids
	16.01.04	knowledge of materials such as carbon, ceramics, aramid, metal sinter and organic compounds
	16.01.05	knowledge of types of brake fluids
	16.01.06	knowledge of system operation
	16.01.07	knowledge of manufacturers' specifications
	16.01.08	knowledge of diagnostic procedures
	16.01.09	ability to perform sensory inspection
	16.01.10	ability to evaluate component conditions such as fluid pressure, leakage, wear of brake pad and fluid quality
	16.01.11	ability to perform checks and measurements such as run out, thickness and diameter
	16.01.12	ability to determine causes of failure such as contaminants, abuse and inactivity
	16.01.13	ability to test ride unit

Sub-task

16.02 Diagnoses mechanical braking systems.	**Supporting Knowledge and Abilities**	
	16.02.01	knowledge of types of mechanical braking systems such as disc and drum
	16.02.02	knowledge of components such as levers, cables, linkages, pivots and springs

16.02.03 knowledge of materials such as carbon, ceramics, aramid, metal sinter and organic compounds

16.02.04 knowledge of system operation

16.02.05 knowledge of manufacturers' specifications

16.02.06 knowledge of diagnostic procedures

16.02.07 ability to perform sensory inspection

16.02.08 ability to evaluate component conditions such as seizure and corrosion

16.02.09 ability to perform checks and measurements such as thickness, diameter and free play

16.02.10 ability to determine causes of failure such as contaminants and abuse

16.02.11 ability to test unit

Sub-task

16.03 Diagnoses electric braking systems.

<u>Supporting Knowledge and Abilities</u>

16.03.01 knowledge of types of electric brake systems

16.03.02 knowledge of operation of electric brake systems

16.03.03 knowledge of manufacturers' specifications

16.03.04 knowledge of component functions

16.03.05 ability to select and use tools and equipment such as measuring and diagnostic equipment

16.03.06 ability to identify electric brake system problems

16.03.07 ability to recognize worn, damaged or defective components

Task 17 Repairs braking systems.

Sub-task

17.01 Repairs hydraulic braking systems.

Supporting Knowledge and Abilities

17.01.01	knowledge of hydraulic principles
17.01.02	knowledge of types of hydraulic braking systems such as disc and drum
17.01.03	knowledge of components such as master cylinder, brake line, caliper (slave cylinder), brake pads and fluids
17.01.04	knowledge of materials such as carbon, ceramics, aramid, metal sinter and organic compounds
17.01.05	knowledge of types of brake fluids
17.01.06	knowledge of system operation
17.01.07	knowledge of manufacturers' specifications
17.01.08	ability to remove and replace components such as friction materials, rotors, drums and springs
17.01.09	ability to recondition components such as master cylinder and slave cylinder
17.01.10	ability to set tolerances to manufacturers' specifications
17.01.11	ability to test unit

Sub-task

17.02 Repairs mechanical braking systems.

Supporting Knowledge and Abilities

17.02.01	knowledge of types of mechanical braking systems such as disc and drum
17.02.02	knowledge of components such as levers, cables, linkages, pivots and springs
17.02.03	knowledge of materials such as carbon, ceramics, aramid, metal sinter and organic compounds
17.02.04	knowledge of system operation

	17.02.05	knowledge of manufacturers' specifications
	17.02.06	ability to remove and replace components such as pads, cables, pivots and drums
	17.02.07	ability to set tolerances to manufacturers' specifications
	17.02.08	ability to test unit

Sub-task

17.03 Repairs electric braking systems.	**<u>Supporting Knowledge and Abilities</u>**
17.03.01	knowledge of electric brake system components such as controllers and magnets
17.03.02	knowledge of component functions
17.03.03	knowledge of manufacturers' specifications
17.03.04	knowledge of component replacement procedures
17.03.05	knowledge of electric brake components that can be repaired, replaced or adjusted
17.03.06	ability to remove components
17.03.07	ability to replace or reinstall electric brake components
17.03.08	ability to repair electric brake components to manufacturers' specifications
17.03.09	ability to adjust electric brakes

BLOCK E

Fuel and Exhaust Systems

Trends: *Fuel and exhaust systems on both marine and outdoor power equipment have benefited from engineering enhancements such as the use of advanced fuel management systems. These computer-controlled fuel management systems provide better fuel economy and quieter operation. Consumer demand for ATVs and similar multi-wheeled vehicles with higher performance have resulted in the availability of superchargers and turbochargers on select units.*

Task 18 Diagnoses fuel systems.

Sub-task

18.01 Diagnoses carburetors.

Supporting Knowledge and Abilities

18.01.01	knowledge of types of carburetors such as butterfly, constant velocity and mechanical slide
18.01.02	knowledge of carburetor components such as float, needle, seat, venture and jets
18.01.03	knowledge of carburetor operation
18.01.04	knowledge of manufacturers' specifications
18.01.05	knowledge of diagnostic procedures
18.01.06	knowledge of today's fuels such as ethanol, bio fuels and diesel
18.01.07	ability to perform sensory inspection
18.01.08	ability to evaluate component conditions such as plugged jets and contaminated fuel
18.01.09	ability to perform checks and measurements such as calibration, synchronization and float height
18.01.010	ability to determine causes of failure

Sub-task

18.02 Diagnoses fuel injection systems.

Supporting Knowledge and Abilities

18.02.01	knowledge of types of fuel injection systems such as sequential and group
18.02.02	knowledge of fuel injection system components such as injectors, fuel rail, regulators and throttle body
18.02.03	knowledge of fuel injection system operation
18.02.04	knowledge of manufacturers' specifications
18.02.05	knowledge of diagnostic procedures
18.02.06	knowledge of electronic controls
18.02.07	ability to perform sensory inspection
18.02.08	ability to evaluate component conditions such as clogged injectors, leaks and contaminated fuel
18.02.09	ability to perform checks and measurements such as pressure test, volume test and injector test
18.0210	ability to determine causes of failure

Sub-task

18.03 Diagnoses fuel tanks and components.

Supporting Knowledge and Abilities

18.03.01	knowledge of types of fuel tanks such as steel, aluminum and composite
18.03.02	knowledge of fuel tank components such as petcocks, pumps, valves, sending units and filler caps
18.03.03	knowledge of fuel tank operation
18.03.04	knowledge of manufacturers' specifications
18.03.05	knowledge of diagnostic procedures
18.03.06	ability to perform sensory inspection

	18.03.07	ability to evaluate component conditions such as rust in tank, clogged filters and leaks
	18.03.08	ability to perform checks and measurements such as pressure, volume, sending unit operation and vacuum operation
	18.03.09	ability to determine causes of failure

Sub-task

18.04	**Diagnoses superchargers.**	**<u>Supporting Knowledge and Abilities</u>**
	18.04.01	knowledge of types of superchargers such as ramchargers
	18.04.02	knowledge of supercharger operation
	18.04.03	knowledge of manufacturers' specifications
	18.04.04	knowledge of lubrication systems
	18.04.05	knowledge of supercharger components such as wastegate, impellers, seals, bearings and bushings
	18.04.06	ability to perform sensory inspections
	18.04.07	ability to evaluate component conditions such as wastegate seizure and seal leaking
	18.04.08	ability to perform checks and measurements such as impeller clearance, pressure test and vacuum test
	18.04.09	ability to determine causes of failure

Sub-task

18.05	**Diagnoses air delivery systems.**	**<u>Supporting Knowledge and Abilities</u>**
	18.05.01	knowledge of types of air delivery systems such as forced air induction and conventional air filtration

18.05.02	knowledge of air delivery system component such as air filter, air box and air sensors
18.05.03	knowledge of air delivery system operation
18.05.04	knowledge of manufacturers' specifications
18.05.05	knowledge of diagnostic procedures
18.05.06	ability to perform sensory inspections
18.05.07	ability to evaluate component conditions such as contamination, leaks and restrictions
18.05.08	ability to perform checks and measurements such as vacuum test and air flow test
18.05.09	ability to determine causes of failure

Task 19 Repairs fuel systems.

Sub-task

19.01 Repairs carburetors.

Supporting Knowledge and Abilities

19.01.01	knowledge of types of carburetors such as butterfly, constant velocity and mechanical slide
19.01.02	knowledge of carburetor components such as float, needle, seat, venturi and jets
19.01.03	knowledge of carburetor operation
19.01.04	knowledge of test equipment
19.01.05	knowledge of manufacturers' specifications
19.01.06	ability to remove and replace components
19.01.07	ability to recondition carburetor body
19.01.08	ability to correct causes of failure
19.01.09	ability to set tolerances within manufacturers' specifications

Sub-task

19.02	**Repairs fuel injection systems.**	**Supporting Knowledge and Abilities**
	19.02.01	knowledge of types of fuel injection systems such as sequential and group
	19.02.02	knowledge of fuel injection system components such as injectors, fuel rail, regulators and throttle body
	19.02.03	knowledge of test equipment
	19.02.04	knowledge of fuel injection system operation
	19.02.05	knowledge of manufacturers' specifications
	19.02.06	ability to remove and replace components
	19.02.07	ability to recondition components such as injectors and throttle body
	19.02.08	ability to correct causes of failure
	19.02.09	ability to set tolerances within manufacturers' specifications

Sub-task

19.03	**Repairs fuel tanks and components.**	**Supporting Knowledge and Abilities**
	19.03.01	knowledge types of fuel tanks such as steel, aluminum and composite
	19.03.02	knowledge of fuel tank components such as petcocks, pumps, valves, sending units, filler caps and venting systems
	19.03.03	knowledge of fuel tank operation
	19.03.04	knowledge of manufacturers' specifications
	19.03.05	ability to remove and replace components
	19.03.06	ability to recondition components such as tanks, petcocks and filler caps

	19.03.07	ability to correct causes of failure
	19.03.08	ability to set tolerances within manufacturers' specifications

Sub-task

19.04	**Repairs superchargers.**	**Supporting Knowledge and Abilities**
	19.04.01	knowledge of types of superchargers such as ramchargers
	19.04.02	knowledge of supercharger operation
	19.04.03	knowledge of manufacturers' specifications
	19.04.04	knowledge of lubrication systems
	19.04.05	knowledge of supercharger components such as wastegate, impellers, seals, bearings and bushings
	19.04.06	ability to remove and replace components
	19.04.07	ability to set tolerances within manufacturers' specifications
	19.04.08	ability to recondition components such as air filters, seals, bearings and bushing
	19.04.09	ability to correct causes of failure

Sub-task

19.05	**Repairs air delivery systems.**	**Supporting Knowledge and Abilities**
	19.05.01	knowledge of types of air delivery systems such as forced air induction and conventional air filtration
	19.05.02	knowledge of air delivery system components such as air filter, air box and air sensors
	19.05.03	knowledge of air delivery system operation
	19.05.04	knowledge of manufacturers' specifications
	19.05.05	ability to remove and replace components

19.05.06	ability to recondition components such as air filters and seals
19.05.07	ability to set tolerances within manufacturers' specifications
19.05.08	ability to correct causes of failure

Task 20 Diagnoses exhaust systems.

Sub-task

20.01 Diagnoses exhaust components.

Supporting Knowledge and Abilities

20.01.01	knowledge of types of exhaust systems such as two-stroke and four-stroke
20.01.02	knowledge of exhaust system components such as muffler, spark arrestor, header pipe, expansion chamber, exhaust variable valve, catalytic converter and O_2 sensor
20.01.03	knowledge of air injection system operation
20.01.04	knowledge of exhaust system operation
20.01.05	knowledge of manufacturers' specifications
20.01.06	knowledge of diagnostic procedures
20.01.07	ability to perform sensory inspection
20.01.08	ability to evaluate component conditions such as restricted pipe and cracks
20.01.09	ability to perform checks and measurements such as exhaust gas analysis and exhaust control valve check
20.01.10	ability to determine causes of failure

Sub-task

20.02 Diagnoses turbochargers. **Supporting Knowledge and Abilities**

20.02.01	knowledge of turbocharger components such as wastegate, impellers, seals and bushings
20.02.02	knowledge of turbocharger operation
20.02.03	knowledge of manufacturers' specifications
20.02.04	knowledge of diagnostic procedures
20.02.05	ability to perform sensory inspection
20.02.06	ability to evaluate component conditions such as wastegate seizure and seal leaking
20.02.07	ability to perform checks and measurements such as impeller clearance, pressure test and vacuum test
20.02.08	ability to determine causes of failure

Task 21 Repairs exhaust systems.

Sub-task

21.01 Repairs exhaust components. **Supporting Knowledge and Abilities**

21.01.01	knowledge of types of exhaust systems such as two-stroke and four-stroke
21.01.02	knowledge of exhaust system components such as muffler, spark arrestor, header pipe, expansion chamber, exhaust variable valve, catalytic converter and O_2 sensor
21.01.03	knowledge of air injection system operation
21.01.04	knowledge of exhaust system temperature and operation
21.01.05	knowledge of manufacturers' specifications
21.01.06	ability to remove and replace components

21.01.07	ability to perform reconditioning such as repacking and decarbonizing
21.01.08	ability to correct causes of failure
21.01.09	ability to set tolerances within manufacturers' specifications

Sub-task

21.02 Repairs turbochargers.

Supporting Knowledge and Abilities

21.02.01	knowledge of turbocharger components such as wastegate, impellers, seals and bushings
21.02.02	knowledge of turbocharger operation
21.02.03	knowledge of manufacturers' service limits and procedures
21.02.04	ability to remove and replace components
21.02.05	ability to recondition components such as wastegate, bushings and seals
21.02.06	ability to correct causes of failure
21.02.07	ability to set tolerances within manufacturers' specifications

BLOCK F

Electrical and Electronic Components

Trends: *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.*

Task 22 Diagnoses electrical systems.

Sub-task

22.01 Diagnoses battery and charging systems.

Supporting Knowledge and Abilities

22.01.01	knowledge of electricity such as Ohms law and load line capacity
22.01.02	knowledge of types of batteries such as absorbed glass mat (AGM), lead acid and gel cell
22.01.03	knowledge of types of charging systems such as alternator and generator
22.01.04	knowledge of components of charging systems such as rotors, stators and regulator/rectifiers
22.01.05	knowledge of charging system operation
22.01.06	knowledge of manufacturers' specifications
22.01.07	ability to perform sensory inspection
22.01.08	ability to evaluate component conditions such as melted connectors and battery plate sulphation
22.01.09	ability to perform checks and measurements such as resistance, load testing and voltage output
22.01.10	ability to determine causes of failure

Sub-task

22.02 Diagnoses ignition systems.

Supporting Knowledge and Abilities

22.02.01 knowledge of types of ignition systems such as CDI and TCI

22.02.02 knowledge of ignition system components such as pulsers, coils and CDI units

22.02.03 knowledge of ignition system operation

22.02.04 knowledge of diagnostic procedures

22.02.05 knowledge of manufacturers' specifications

22.02.06 ability to perform sensory inspection

22.02.07 ability to perform checks and measurements such as coil resistance, pulse voltage, air gap and source voltage

22.02.08 ability to determine causes of failure

Sub-task

22.03 Diagnoses starting systems.

Supporting Knowledge and Abilities

22.03.01 knowledge of starting system components such as solenoids, starter drives/clutches and field coils

22.03.02 knowledge of starting system operation

22.03.03 knowledge of manufacturers' specifications

22.03.04 knowledge of diagnostic procedures

22.03.05 ability to perform sensory inspection

22.03.06 ability to evaluate component conditions such as burnt brushes, galled bearing surfaces and damaged starter gears

22.03.07 ability to perform checks and measurements

22.03.08 ability to determine causes of failure

Sub-task

22.04 Diagnoses accessory components.

Supporting Knowledge and Abilities

22.04.01 knowledge of accessory components such as lights, horns, signal systems, audio system, cruise control and security systems

22.04.02 knowledge of operation of accessory components

22.04.03 knowledge of manufacturers' specifications such as operating voltage and resistance

22.04.04 ability to perform sensory inspection

22.04.05 ability to evaluate component conditions such as corrosion and damaged wiring connectors

22.04.06 ability to determine causes of failure

Sub-task

22.05 Diagnoses computer management systems.

Supporting Knowledge and Abilities

22.05.01 knowledge of diagnostic code types

22.05.02 knowledge of diagnostic code protocols and actions

22.05.03 knowledge of operation and interrelationship of modules

22.05.04 knowledge of types and relationship of various parameters

22.05.05 knowledge of parameter definitions

22.05.06 ability to access information on codes

22.05.07 ability to access service information

22.05.08 ability to interpret diagnostic codes

22.05.09 ability to select and organize relevant parameters

22.05.10 ability to use testing equipment such as DVOM, jumper wires, test probes and break out boxes

Task 23 Repairs electrical systems.

Sub-task

23.01 Repairs battery and charging systems.

Supporting Knowledge and Abilities

23.01.01	knowledge of types of batteries such as AGM, lead acid and gel cell
23.01.02	knowledge of types of charging systems such as alternator and generator
23.01.03	knowledge of components of charging systems such as rotors, stators and regulator/rectifiers
23.01.04	knowledge of charging system operation
23.01.05	knowledge of manufacturers' service limits and procedures
23.01.06	knowledge of battery initialization, charging and maintenance procedures
23.01.07	knowledge of safety procedures
23.01.08	knowledge of disposal procedures
23.01.09	ability to remove and replace components
23.01.10	ability to correct causes of failure

Sub-task

23.02 Repairs ignition systems.

Supporting Knowledge and Abilities

23.02.01	knowledge of types of ignition systems such as CDI and TCI
23.02.02	knowledge of ignition system components such as pulsers, coils and CDI units
23.02.03	knowledge of ignition system operation
23.02.04	knowledge of manufacturers' service limits and procedures
23.02.05	knowledge of electrical circuits
23.02.06	ability to remove and replace components

23.02.07 ability to perform adjustments such as spark plug gap, dwell and pulse coil air gap

23.02.08 ability to correct causes of failure such as improper installation of battery and short circuit of wiring

Sub-task

23.03 Repairs starting systems.

Supporting Knowledge and Abilities

23.03.01 knowledge of starting system components such as solenoids, starter drives/clutches and field coils

23.03.02 knowledge of starting system operation

23.03.03 knowledge of manufacturers' service limits and procedures

23.03.04 ability to remove and replace components

23.03.05 ability to recondition armatures

23.03.06 ability to perform measurements

23.03.07 ability to correct causes of failure

Sub-task

23.04 Repairs accessory components.

Supporting Knowledge and Abilities

23.04.01 knowledge of accessory components such as lights, horns, signal systems, audio system, cruise control and security systems

23.04.02 knowledge of operation of accessory components

23.04.03 knowledge of manufacturers' specifications

23.04.04 ability to rewire components

23.04.05 ability to correct causes of failure

Sub-task

23.05 Repairs computer management systems.

Supporting Knowledge and Abilities

23.05.01	knowledge of methods of software transfer
23.05.02	knowledge of basic computer processes
23.05.03	knowledge of types of components such as control module, wire harnesses, input and output devices
23.05.04	knowledge of replacement procedures such as transfer of programmable read only memory (PROM)
23.05.05	knowledge of circuit orientation such as twisted pair and shielded wire
23.05.06	knowledge of types of wiring procedures such as soldering and crimping
23.05.07	knowledge of methods of verifying repair such as clear codes, retest and road test using drive cycles
23.05.08	ability to select software
23.05.09	ability to interpret calibrations
23.05.10	ability to transfer/access software using methods such as CD, Internet and PROM replacement
23.05.11	ability to reconfigure modules
23.05.12	ability to locate components using service information
23.05.13	ability to follow vehicle-specific cautionary procedures such as using anti-static strap
23.05.14	ability to interpret wiring diagrams
23.05.15	ability to select terminals
23.05.16	ability to use scan tools to reset system and compare parameters
23.05.18	ability to select test environment

BLOCK G

Plumbing

Trends: *Plumbing on marine equipment has benefited from engineering enhancements originating from the plumbing industry. For example, the use of the latest lighter-weight PVC-type materials are used for plumbing applications on marine products.*

Task 24 Diagnoses plumbing systems.

Sub-task

24.01 Diagnoses pumps, hoses and components.

Supporting Knowledge and Abilities

24.01.01	knowledge of types of pumps such as bilge pumps, aerators, electrical and manual
24.01.02	knowledge of operation of pumps, valves and fixture
24.01.03	knowledge of plumbing components such as tubing and fittings
24.01.04	knowledge of flushing and sanitizing procedures
24.01.05	knowledge of types of hoses such as bilge, waste, and fuel
24.01.06	knowledge of types of fasteners such as hose clamps
24.01.07	knowledge of water systems such as toilets, faucets and showers
24.01.08	ability to winterize and de-winterize
24.01.09	ability to identify leaks
24.01.10	ability to identify obstruction locations
24.01.11	ability to identify venting problems
24.01.12	ability to identify electrical problems

Sub-task

24.02	**Diagnoses tanks and ballasts.**	**Supporting Knowledge and Abilities**
	24.02.01	knowledge of types of tanks such as potable water and waste water
	24.02.02	knowledge of ballasts
	24.02.03	knowledge of flushing and sanitizing procedures such as chemicals, antifreeze and how they apply to potable or waste water systems
	24.02.04	knowledge of disposal of waste byproducts
	24.02.05	knowledge of fasteners
	24.02.06	knowledge of flow or flood test procedures
	24.02.07	ability to winterize and de-winterize
	24.02.08	ability to identify leaks
	24.02.09	ability to identify obstruction locations
	24.02.10	ability to identify venting problems
	24.02.11	ability to identify electrical problems such as solenoid valve

Task 25 Repairs plumbing systems.

Sub-task

25.01	**Repairs pumps, hoses and components.**	**Supporting Knowledge and Abilities**
	25.01.01	knowledge of types of pumps such as bilge pumps, aerators, electrical and manual
	25.01.02	knowledge of operation of pumps, valves and fixture
	25.01.03	knowledge of plumbing components such as tubing and fittings

25.01.04	knowledge of flushing and sanitizing procedures
25.01.05	knowledge of types of hoses such as bilge, waste, and fuel
25.01.06	knowledge of types of fasteners such as hose clamps
25.01.07	knowledge of water systems such as toilets, faucets and showers
25.01.08	ability to repair leaks
25.01.09	ability to repair obstruction locations
25.01.10	ability to repair venting problems
25.01.11	ability to repair electrical problems
25.01.12	ability to remove and replace pumps, hoses and various components

Sub-task

25.02 Repairs tanks and ballasts.

Supporting Knowledge and Abilities

25.02.01	knowledge of types of tanks such as potable water and waste water
25.02.02	knowledge of ballasts
25.02.03	knowledge of flushing and sanitizing procedures such as chemicals, antifreeze and how they apply to potable or waste water systems
25.02.04	knowledge of disposal of waste byproducts
25.02.05	knowledge of fasteners
25.02.06	knowledge of flow or flood test procedures
25.02.07	ability to clean, drain and fill tanks
25.02.08	ability to test tanks for leaks and repair leaks
25.02.09	ability to repair obstruction locations

25.02.10	ability to repair venting problems
25.02.11	ability to repair electrical problems such as solenoid valve
25.02.12	ability to remove and replace components

BLOCK H

Assembly and Pre-delivery

Trends: *In general, manufacturers have moved towards shipment of marine and outdoor power equipment that is nearly ready for use. More accessories are becoming standard or optional equipment. Although units come almost fully assembled, the availability of an expanding selection of both OEM and aftermarket accessories means that technicians must be knowledgeable about the applications and installations of these accessories.*

Task 26 Unit assembly and rigging.

Sub-task

26.01 Pre-inspects new units before assembly.

Supporting Knowledge and Abilities

26.01.01	knowledge of manufacturers' uncrating and assembly procedures
26.01.02	knowledge of all unit components
26.01.03	ability to check for shipping damage
26.01.04	ability to uncrate unit
26.01.05	ability to verify serial numbers and model type
26.01.06	ability to determine extent of assembly required

Sub-task

26.02 Assembles products according to manufacturers' specifications.

Supporting Knowledge and Abilities

26.02.01	knowledge of types of units and options
26.02.02	knowledge of connections and adapters
26.02.03	knowledge of adjustments
26.02.04	ability to install and set required components according to specifications and conditions (rigging)
26.02.05	ability to remove protective coatings
26.02.06	ability to locate and interpret charts

26.02.07	ability to ballast equipment
26.02.08	ability to verify optimal performance of equipment

Task 27 Performs pre-delivery inspection (PDI).

Sub-task

27.01 Performs pre-delivery adjustments.

Supporting Knowledge and Abilities

27.01.01	knowledge of manufacturers' recommended procedures
27.01.02	ability to identify quality control problems and service bulletins
27.01.03	ability to perform duties on factory PDI checklist such as filling and checking fluids, servicing batteries and checking fastener torque settings
27.01.04	ability to perform duties on safety inspection checklist such as checking component integrity and function
27.01.05	ability to perform operational tests on units

Sub-task

27.02 Explains operation of vehicle before delivery.

Supporting Knowledge and Abilities

27.02.01	knowledge of jurisdictional and company safety inspection requirements
27.02.02	knowledge of licensing requirements to perform safety inspection
27.02.03	ability to demonstrate safe vehicle and component operation according to dealer and manufacturer checklists

BLOCK I

Marine and Outdoor Power Equipment Components

Trends: *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.*

Task 28 Diagnoses operator controls.

Sub-task

28.01 Diagnoses control boxes.

Supporting Knowledge and Abilities

28.01.01	knowledge of types of control boxes such as electrical, mechanical, hand/foot controls
28.01.02	knowledge of function of control boxes such as cables, harnesses, and mechanical levers
28.01.03	knowledge of electricity
28.01.04	knowledge of manufacturer's specifications
28.01.05	knowledge of diagnostic procedures
28.01.06	ability to test and interpret controls
28.01.07	ability to identify fasteners
28.01.08	ability to perform sensory inspections
28.01.09	ability to determine causes of failure
28.01.10	ability to perform checks and measurements

Sub-task

28.02 Diagnoses hydraulic systems.

Supporting Knowledge and Abilities

28.02.01	knowledge of the basic theory of hydraulic systems
28.02.02	knowledge of the types and properties of hydraulic systems

28.02.03	knowledge of mechanically-controlled and electronically-controlled hydraulic systems
28.02.04	knowledge of hydraulic system components such as pumps, cylinders and valves
28.02.05	knowledge of sensor functions
28.02.06	knowledge of common faults such as chafed or broken hoses and leaks
28.02.07	ability to identify power supplying drive systems
28.02.08	ability to verify fluid types and levels
28.02.09	ability to interpret hydraulic test results
28.02.10	ability to retrieve and interpret error codes
28.02.11	ability to perform sensory inspections
28.02.12	ability to verify whether the mechanically or electronically-controlled system is at fault
28.02.13	ability to interpret flow schematics and specifications
28.02.14	ability to determine causes of failure

Task 29 Repairs operator controls.

Sub-task

29.01 Repairs control boxes. **<u>Supporting Knowledge and Abilities</u>**

29.01.01	knowledge of types of control boxes such as electrical, mechanical, hand/foot controls
29.01.02	knowledge of function of control boxes such as cables, harnesses, and mechanical levers
29.01.03	knowledge of electricity
29.01.04	knowledge of manufacturer's specifications

29.01.05	knowledge of diagnostic procedures
29.01.06	ability to remove and replace components
29.01.08	ability to set tolerances within manufacturers' specifications
29.01.09	ability to correct causes of failure

Sub-task

29.02 Repairs hydraulic systems.

Supporting Knowledge and Abilities

29.02.01	knowledge of electrical components such as pumps, switches, relays and solenoids
29.02.02	knowledge of the basic theory of hydraulic systems
29.02.03	knowledge of the types and properties of hydraulic systems
29.02.04	ability to remove and disassemble components to determine failure
29.02.05	ability to repair and replace power supplying drive systems
29.02.06	ability to repair and replace hydraulic system components such as pumps, cylinders and valves
29.02.07	ability to repair faults such as chafed seals, burst and leaking hoses and bearings
29.02.08	ability to assemble, install and adjust components

APPENDICES

Appendix “A”

Tools and Equipment

Safety and First Aid Equipment

dust mask
protectors
ear protectors
eye wash station
face shield
fire blanket
fire extinguishers
first aid kit
gloves
goggles
latex gloves
personal protective clothing
safety cage
safety signs
shields and guards
welder’s helmet
welding curtains

Measuring Devices

air pressure gauge
alignment tool
ball gauge
boring bar
caliper
carburetor float level gauge
coolant tester
cylinder bore gauge
degree wheel
dial indicator
engine tachometer
feeler gauge
graduated cylinder
height gauge
hydrometer
inclinometer
inside micrometer
inside/outside calipers
micrometer
multimeter
oil pressure gauge
plastigage
pounds pull gauge
protractor (magnetic)
steel rule
straightedge
straightedge gauge
tape measure
telescopic gauge
tension gauge
thickness gauge
tire pressure gauge
torque wrench
tread depth gauge
vacuum gauge
vernier caliper

Diagnostic and Testing Tools

alignment tool
borescope
coil tester
compression tester
crankcase pressure test equipment
hydrometer
leak-down tester
multimeter
pressure tester
stethoscope
test light
timing light
vacuum gauge
vacuum pump

load tester

Hand Tools

4-way pick set
Allen wrenches
bearing driver
bearing puller
brass mallet
bushing and seal driver
circlip pliers
combination wrench set
crimping tool
dead-blow hammer
file
flashlight
jumper lead set alligator clip
lock wrench
magnetic pickup tool
mirror
mechanics fingers
pliers
plug socket
probe
pry bar
punch
rubber mallet
screwdriver set
snap ring pliers
sockets and adapters
test light for power
utility knife
wire brush
wire connector
wire cutting tool
wire stripping tool
wrench set

Pneumatic and Electric Power Tools

compressed air gun
drills
grinder
hydraulic jack
hydraulic press
impact driver
impact tool
riveting equipment
rotary tool
spring shock compressor
valve spring compressor

Cutting/Heating Tools and Equipment

electric arc welding equipment
heat gun
oxyacetylene welding and cutting equipment
propane torch
soldering equipment

Shop Tools and Equipment

air chuck
alignment bars
ball hone
battery charger
lifting equipment
line lap
magnetic base
nitrogen recharging unit

battery terminal cleaner
bearing installation tool
bench grinder
bleeding equipment
brake cylinder hone
cable lubber
carbon scraper
chain breaker
computer diagnostic equipment
crank aligning jig
crank installer
crankcase separator
crankshaft puller
cylinder hone
damper rod holder
degree wheel
dynometer
electrical termination tool
electronic diagnostic equipment
fluid extractor
frame jig
gasket remover
gasket scraper
grinder
guide installation pilot
hacksaw with blades
hand pump
headlight aiming equipment
hone
honing stone
"O"-ring tool set
piston pin puller
reamers
ring compressor
riveting tools
rotary drive shaft puller
scraper
seal driver
seal installer
seal remover
slide hammer
spark plug gauge
tensioner socket
threaded insert
tin snips
tirebalancing equipment
tire iron
tire machine
tire mounting equipment
torque plates
torx wrench
truing jack
valve resurfacing tool
valve seat cutter
v-block
vice
water bath
wheel balancing equipment
wheel jig

Appendix “B”

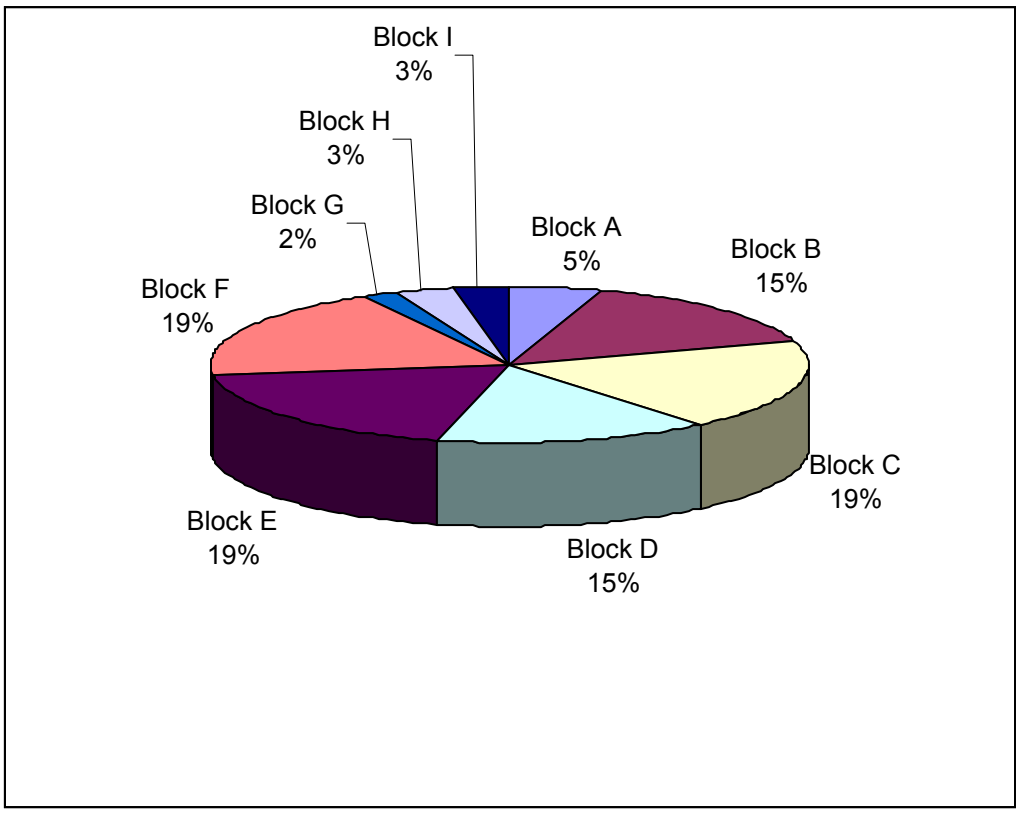
Acronyms

AGM	Absorbed Glass Mat Battery
ATV	All-Terrain Vehicle
CDI	Capacitor (or Compositor) Discharge Ignition
DTS	Digital Throttle and Shift
DVOM	Digital Ohm Voltmeter
MSDS	Material Safety Data Sheet
OBD II	On-Board Diagnostic System
OEM	Original Equipment Manufacturer
ORV	Off-Road Vehicle
PDI	Pre-delivery Inspection
PPE	Personal Protective Equipment
PROM	Programmable Read Only Memory
PWC	Personal Watercraft
TCI	Transistor Control Ignition
WHMIS	Workplace Hazardous Materials Information System

Appendix “C”
Block Percentages*
Titles of Blocks

Block A	Occupational Skills	5%
Block B	Engine and Engine Support Systems	15%
Block C	Drivetrains	19%
Block D	Chassis, Steering, Suspension and Brakes	15%
Block E	Fuel and Exhaust Systems	19%
Block F	Electrical and Electronic Components	19%
Block G	Plumbing	2%
Block H	Assembly and Pre-delivery	3%
Block I	Marine and Outdoor Power Equipment Components	3%

* The percentages reflect the average amount of time workers within the occupation spend performing these tasks on a yearly basis.



Appendix “D”
DACUM Chart – Task Profile Chart

Marine and Outdoor Power Equipment Technician

BLOCKS	TASKS	SUB-TASKS				
A OCCUPATIONAL SKILLS	1. Uses tools and equipment.	1.01 Uses personal protective equipment (PPE) and safety equipment.	1.02 Uses hand tools.	1.03 Uses power tools.	1.04 Uses and tests diagnostic tools.	1.05 Uses cutting and heating tools and equipment.
		1.06 Uses hoisting, lifting and securing equipment.	1.07 Uses measuring tools.			
	2. Organizes work.	2.01 Uses documentation and reference tools.	2.02 Communicates with others.	2.03 Plans daily tasks.		
	3. Performs routine trade activities.	3.01 Maintains safe work environment.	3.02 Uses fasteners, sealants, adhesives and gaskets.	3.03 Cleans parts and components.	3.04 Lubricates parts and components.	3.05 Maintains fluids and lubricants.
		3.06 Maintains bearings/ bushings and seals.	3.07 Verifies equipment installations and repairs.			
B ENGINE AND ENGINE SUPPORT SYSTEMS	4. Performs engine diagnostics.	4.01 Diagnoses two-stroke engines.	4.02 Diagnoses four-stroke engines.			
	5. Repairs engines and engine support systems.	5.01 Repairs two-stroke engines.	5.02 Repairs four-stroke engines.			
C DRIVETRAINS	6. Diagnoses clutches and primary drive systems.	6.01 Diagnoses automatic clutches.	6.02 Diagnoses manual-start systems.	6.03 Diagnoses primary drive belts, pulleys and chains.	6.04 Diagnoses manual clutches.	

BLOCKS	TASKS	SUB-TASKS			
	7. Repairs clutches and primary drives.	7.01 Repairs automatic clutches.	7.02 Repairs manual-start systems.	7.03 Repairs primary drive belts, pulleys and chains.	7.04 Repairs manual clutches.
	8. Diagnoses transmissions.	8.01 Diagnoses constant mesh systems.	8.02 Diagnoses variable-ratio belt transmissions.	8.03 Diagnoses automatic and fluid-drive transmissions.	
	9. Repairs transmissions.	9.01 Repairs constant mesh systems.	9.02 Repairs variable-ratio belt transmissions.	9.03 Repairs automatic and fluid-drive transmissions.	
	10. Diagnoses final drives.	10.01 Diagnoses final drive shafts and gears.	10.02 Diagnoses final drive chains, sprockets, belts and pulleys.		
	11. Repairs final drives.	11.01 Repairs final drive shafts and gears.	11.02 Repairs final drive chains sprockets, belts and pulleys.		
D CHASSIS, STEERING, SUSPENSION, BRAKES AND TIRES	12. Diagnoses chassis and steering systems.	12.01 Diagnoses frames and structural components.	12.02 Diagnoses manual steering systems.	12.03 Diagnoses electronic and hydraulic steering systems.	
	13. Repairs chassis and steering systems.	13.01 Repairs frames and structural components.	13.02 Repairs manual steering systems.	13.03 Repairs electronic and hydraulic steering systems.	
	14. Diagnoses suspensions.	14.01 Diagnoses front suspensions.	14.02 Diagnoses rear suspensions.	14.03 Diagnoses wheel/tracks and undercarriages.	
	15. Repairs suspensions.	15.01 Repairs front suspensions.	15.02 Repairs rear suspensions.	15.03 Repairs wheel/tracks and undercarriages.	

BLOCKS	TASKS	SUB-TASKS				
	16. Diagnoses braking systems.	16.01 Diagnoses hydraulic braking systems.	16.02 Diagnoses mechanical braking systems.	16.03 Diagnoses electric braking systems.		
	17. Repairs braking systems.	17.01 Repairs hydraulic braking systems.	17.02 Repairs mechanical braking systems.	17.03 Repairs electric braking systems.		
E FUEL AND EXHAUST SYSTEMS	18. Diagnoses fuel systems.	18.01 Diagnoses carburetors.	18.02 Diagnoses fuel injection systems.	18.03 Diagnoses fuel tanks and components.	18.04 Diagnoses superchargers.	18.05 Diagnoses air delivery systems.
	19. Repairs fuel systems.	19.01 Repairs carburetors.	19.02 Repairs fuel injection systems.	19.03 Repairs fuel tanks and components.	19.04 Repairs superchargers.	19.05 Repairs air delivery systems.
	20. Diagnoses exhaust systems.	20.01 Diagnoses exhaust components.	20.02 Diagnoses turbochargers.			
	21. Repairs exhaust systems.	21.01 Repairs exhaust components.	21.02 Repairs turbochargers.			
F ELECTRICAL AND ELECTRONIC COMPONENTS	22. Diagnoses electrical systems.	22.01 Diagnoses battery and charging systems.	22.02 Diagnoses ignition systems.	22.03 Diagnoses starting systems.	22.04 Diagnoses accessory components.	22.05 Diagnoses computer management systems.
	23. Repairs electrical systems.	23.01 Repairs battery and charging systems.	23.02 Repairs ignition systems.	23.03 Repairs starting systems.	23.04 Repairs accessory components.	23.05 Repairs computer management systems.
G PLUMBING	24. Diagnoses plumbing systems.	24.01 Diagnoses pumps, hoses and components.	24.02 Diagnoses tanks and ballasts.			

BLOCKS	TASKS	SUB-TASKS	
	25. Repairs plumbing systems.	25.01 Repairs pumps, hoses and components.	25.02 Repairs tanks and ballasts.
H ASSEMBLY AND PRE-DELIVERY	26. Unit assembly and rigging.	26.01 Pre-inspects new units before assembly.	26.02 Assembles products according to manufacturers' specifications.
	27. Performs pre-delivery inspection (PDI).	27.01 Performs pre-delivery adjustments.	27.02 Explains operation of vehicle before delivery.
I MARINE AND OUTDOOR POWER EQUIPMENT COMPONENTS	28. Diagnoses operator controls.	28.01 Diagnoses control boxes.	28.02 Diagnoses hydraulic systems.
	29. Repairs operator controls.	29.01 Repairs control boxes.	29.02 Repairs hydraulic systems.