



REGISTERED NATIONAL STANDARD

UNIT OF COMPETENCY

Title:	Operate marine outboard engines				
TQF Level:	3	Credits:	25	Release:	1
National standard code:	NS116-03				
Associated qualification (and code):	National certificate in whale watching and swimming guide Level 3 (QR-03-NQ-005-01-0903-24-01)				
Approval date:	13 June 2024		Review date:	13 June 2029	
Purpose:	This unit standard involves working with tools and equipment used for routine mechanical engineering. Persons credited with this unit standard are able to demonstrate the knowledge and skills required for general operation, troubleshooting and maintaining: 1. 2-stroke and 4-stroke engines; 2. Ignition systems; 3. Diesel and petrol fuel systems; 4. Engines cooling systems; 5. Lubrication systems; and 6. Gearboxes				

Learning Outcome 1 (LO1)	Demonstrate knowledge of how 2-stroke and 4-stroke engines operate
Performance standards	1.1 Describe what an <i>internal combustion engine</i> is; 1.2 Describe what an <i>engine stroke</i> is, in the context of combustion engines; 1.3 Describe the main differences between a <i>2-stroke engine</i> and a <i>4-stroke engine</i> 1.4 Outline the advantages of '4-stroke engines' over 2-stroke engines; 1.5 Outline the advantages of 2-stroke engines' over 4-stroke engines; 1.6 Identify a variety of '2-stroke' engines and '4-stroke' engines; [Range of engines: include but not limited to: 2-strokes: <i>Outboard motors, Jet skis, Lawn mowers</i>; and 4-stroke outboard motors]
Learning Outcome 2 (LO2)	Demonstrate procedural knowledge of ignition systems and their operation
Performance standards	2.1 Describe what an <i>ignition system</i> is; 2.2 Identify different types of ignition systems; 2.3 Identify the main parts of an ignition system; 2.4 Describe the functions of the main parts of an ignition system; 2.5 Describe how to use a named testing equipment to test an ignition system; 2.6 Describe common symptoms of ignition system problems; [Range symptoms include but not restricted to: <i>engine knocks, difficulty in starting, incomplete combustion and excessive smoke, warning lights and diagnostic trouble codes</i>] 2.7 Troubleshoot and fix common problems associated with ignition systems.
Learning outcome 3 (LO3)	Demonstrate knowledge of <i>starting</i> and <i>charging systems</i> [Range of starting systems includes but not limited to: <i>electric, hydraulic, air motor, and compressed air admission</i>]
Performance standards	3.1 Describe what <i>starting system</i> is; 3.2 Describe what a <i>charging system</i> is: 3.3 Identify different types of starting systems; 3.4 Identify the main parts of a starting system and a charging system; 3.5 Describe common symptoms of starting system problems; 3.6 Describe how to use named testing equipment to test a starting system

	and charging system; 3.7 Troubleshoot and fix common problems associated with starting systems and charging systems.
Learning Outcome 4 (LO4)	Demonstrate knowledge of petrol and diesel <i>fuel systems</i>
Performance Standards	4.1 Describe what a <i>fuel system</i> is and what its main functions are; 4.2 Identify the parts of a fuel system in both petrol and diesel engines; 4.3 Describe the function of each part of a fuel system in both petrol and diesel engines; 4.4 Describe standard maintenance procedure for a fuel system; 4.5 Describe common symptoms of fuel system problems (or faults); [Range includes but not restricted to: <i>engine not starting (or hard to start), fuel pump not working properly, fuel line blockages, water in fuel, etc.</i>] 4.6 Troubleshoot and fix common fuel system problems.
Learning Outcome 5 (LO5)	Demonstrate knowledge of engine cooling systems [Range of types include but not restricted to: <i>seawater cooling system, freshwater or central cooling system</i>]
Performance standards	5.1 Describe the main functions of an engine <i>cooling system</i>. 5.2 Identify the main parts of a cooling system. 5.3 Describe the function of the main parts of a cooling system. 5.4 Identify a variety of cooling systems: [Range of systems: <i>cooling systems for marine engines, cooling systems in engines in automobiles</i>]. 5.5 Describe how the cooling system for a marine engine works differently from that for an engine for non-aquatic environment 5.6 Troubleshoot and fix a variety of common problems associated cooling systems: [Range of common problems include but not restricted to: <i>over-heating, blockages of water lines blockages, etc.</i>]
Learning Outcome 6 (LO5)	Demonstrate knowledge of <i>lubrication systems</i>
Performance standards	6.1 Describe the main function(s) of an engine lubrication system; 6.2 Identify the main parts of a lubrication system, and describe the function of each part; 6.3 Describe the key differences between the lubrication system of a 2-stroke engine and that of a 4-stroke engine. 6.4 Describe how the lubrication system for a marine engine differs from that

	of an an engine for non-aquatic environments 6.5 Identify the ideal <i>viscosity of lubricants</i> for a marine engines 6.6 Describe standard maintenance procedure for marine lubrication systems. 6.7 Troubleshoot and fix common problems associated with marine lubrication systems.
Learning Outcome 7 (LO7)	Demonstrate knowledge of how a marine gearbox and propeller work
Performance standards	7.1 Identify the gearbox system and the propeller of a marine engine; 7.2 Describe the main functions of a marine gearbox system and its accompanying propeller; 7.3 Describe different types of gearboxes used on marine engines; 7.4 Identify the most appropriate type and viscosity of lubrication oil to lubricate a marine gearbox; 7.5 Troubleshoot and fix common problems associated with a marine gearbox and its propeller; [Range of problems may include but not restricted to: <i>no oil, leakages, linkages (problems with gear engaging/disengaging)</i>]
Pre-requisites	NS024-04
Co-requisites	N/A
Underpinning skills and knowledge	The following knowledge and skills underpin this unit standard: <u>KNOWLEDGE:</u> 1) Internal combustion engine 2) <i>Strokes</i> and phases of the engine cycle. 3) <i>2-stroke</i> and <i>4-stroke</i> engines 4) Engine systems (types, structure, parts, functions, trouble-shooting and maintenance): a) Ignition systems b) Starting systems c) Charging systems d) Fuel systems e) Cooling systems f) Lubrication systems g) Gearboxes – anatomy <u>SKILLS:</u> 5) Testing ignition and starting systems 6) Trouble-shooting and fixing of problems in:

	a) Ignition systems b) Starting systems c) Fuel systems d) Cooling systems e) Lubrication systems f) Gearboxes 7) General maintenance of: a) Ignition systems b) Starting systems and charging systems c) Fuel systems d) Cooling systems e) Lubrication systems f) Gearboxes
Assessment requirements	<u>Methods of assessment:</u> A range of assessment methods should be used to assess students' knowledge and application of skills. These shall include but not restricted to the following: 1) Direct observation of students performing certain tasks as described below in the <i>context of assessment</i>. 2) Written assessments such as: (i) Poster or chart making – demonstrating procedures (e.g. maintenance and repair) (ii) Written tests (iii) Student portfolios; (iv) Review of workplace attachment reports (e.g. Supervisor/third party reports) 3) Oral assessment as in seminar presentations and one-on-one interview 4) A combination of all of the above methods. Examples: (i) During an observation assessment, and depending on the skills and knowledge that is being assessed, a students may also be required to give oral responses to questions asked by the assessor to clarify or ascertain skills and knowledge during observation; (ii) Students may be required to also submit written answers or report after an observation assessment (or seminar presentation)

Context of assessment:

To support student assessment and to ensure they are valid, reliable, flexible, and fair, a training provider is encouraged to make the necessary arrangements to involve the relevant key industry organizations and experts in the planning and delivery of training. Industry organizations and individuals can be engaged in a variety of capacities:

- a) To contribute to the design and implementation of the curriculum and assessment activities;
- b) As trainers, assessors, or assessment moderators;
- c) As hosts for students on workplace attachment;
- d) As supervisors of students on workplace attachment;
- e) Etc.

To show that learners have attained the required competency they will need to **demonstrate** and **apply** their knowledge in the workplace or in an environment that closely resembles the workplace) in relation to:

- a) LO1: Demonstrating knowledge of how 2-stroke and 4-stroke engines operate
- b) LO2: Demonstrating procedural knowledge of ignition systems and their operation
- c) LO3: Demonstrate knowledge of starting and charging systems
- d) LO4: Demonstrating knowledge of petrol and diesel fuel systems
- e) LO5: Demonstrating knowledge of engine cooling systems
- f) LO6: Demonstrate knowledge of marine lubrication systems
- g) LO7: Demonstrate knowledge of how a marine gearbox and propeller work

Evidence of competence

- 1) The assessment of competence and the collection of evidence must be in accordance with local industry and regulatory requirements;
- 2) Evidence must clearly show that knowledge and skills have been acquired to the expected standards of performance
- 3) All knowledge and skills should be contextualised to current industry practices and technologies;
- 4) Each LO must be demonstrated on at least TWO occasions.
- 5) Sources of evidence need to be rich in nature to minimise error in judgment.

Re-assessment

Candidates of assessment are eligible to **three (3)** attempts to achieve the required competency within **14 days** of their first attempt:

- 1. Feedback must be provided to the candidate and sufficient time provided

	to prepare for re-assessment. 2. The trainer/assessor has the discretion to vary the assessment tasks used in each assessment attempt as long as the: - same competencies are being assessed; - principles of assessment are adhered to. 3. Failure to achieve the required competency after three (3) attempts on the exam or specific part of the assessment will require the person studying this Unit to re-enrol for the same Unit.
Moderation arrangements	1) Training providers must have their own moderation system approved by TNQAB before accreditation is granted: - Relevant internal moderation processes are documented; - Assessment is planned for each unit, and moderation processes are integrated into such plan 2) External moderation is conducted by the national qualifications unit of TNQAB for all unit components of national qualifications; - Samples of assessed activities are submitted for moderation; - Moderation (external) forms are available on request from the National qualifications unit of TNQAB.
Resource requirements	- Four strokes outboard marine engine 60hp - Outboard motor rack - Combination spanner set - Ring spanner set - Spanner wrench and socket set - Multi-meter - Compression test meter - Gearbox lubrication tools - Compilation of relevant teaching resources (online or offline – printed or electronic) at the discretion of trainer/assessor. Examples include but not restricted to: - Printout of this unit - General teaching and assessment (including moderation) plans - Printed resources (book chapters, webpages, etc.) - Printed lists of electronic resources, including titles and locations of multimedia resources and videos (downloaded or web-based).
Requirements to	There are seven (7) Learning outcomes and forty four (44) Performance

complete this unit	standards to measure competence. To demonstrate competence, the person studying this unit is: 1. Required to attain an <i>Achieved</i> Grade (Competent) to fulfil the requirements of the Unit standard; 2. Eligible to three (3) attempts to achieve the required competency within 14 days of the first attempt.
Important notes and definitions	<u>Notes:</u> 1. In the event that local legislations and/or regulatory requirements are not available, relevant legislations/regulatory requirements from New Zealand and/or Australian should be used for training; 2. Assessors must comply with Tonga national assessment and moderation requirements. <u>Definitions:</u> 1. <i>Combustion</i> is just another word for ‘burning’. 2. <i>Engine cooling system</i> is a set of various parts that allow liquid coolant to flow through the engine block and cylinder head passages to absorb the unnecessary engine heat. As the coolant absorbs heat, its temperature increases. 3. <i>Engine fuel system</i> is system which consists of the fuel tank, pump, filter, and injection nozzles or carburetor. A fuel system supplies fuel to the engine as needed. 4. <i>Engine ignition system</i> refers to a set of engine components which a heat engine uses to initiate combustion by igniting the fuel-air mixture. 5. <i>Engine lubrication system</i> is a system that distributes oil to the moving parts of an engine to reduce friction and heat 6. <i>Engine starting system</i>: refers to group of engine components that include the <i>battery and battery cables, starter motor, starter relay, ignition switch, and neutral safety switch</i>. When the key is inserted into the ignition switch and turned it on, the system cranks the engine, which helps initiate the fuel combustion process in the ignition system. 7. <i>Internal combustion engine</i> is a type of heat engine in which a fuel-air mixture is burned inside a combustion chamber which in turn forces the components of the engine to move. Two main types studied in this unit: a. <i>Four (4)-stroke engine</i> is an internal combustion engine in which the piston completes four separate strokes while turning the crankshaft. A stroke refers to the full travel of the piston along the cylinder, in either direction. b. <i>Two (2)-stroke engine</i> is a type of internal combustion engine that completes a power cycle with two strokes (up and down movements) of the piston during one power cycle, this power cycle being completed in one revolution of the crankshaft.

	8. <i>Lubricant</i> (or <i>Lube</i>) is a substance that helps to reduce friction between surfaces which are in contact. 9. <i>Lubrication</i> is the process of using a lubricant to reduce friction and wear and tear in a contact between two surfaces. 10. <i>Phases of the combustion engine cycle</i> refer to the stages of how an engine works. These stages or phases are also known as <i>strokes</i>: a. Intake (also known as <i>induction</i> or <i>suction</i>). b. Compression: c. Combustion (also known as <i>power</i> or <i>ignition</i>) d. Exhaust (also known as <i>outlet</i>) 11. <i>Viscosity of lubricants</i>: is the resistance of a fluid to flow due to the friction between its molecules. Water has a low viscosity when compared to oil since water molecules resist each other less when compared to resistance between oil molecules themselves.
Public comments on unit	Please contact TNQAB National Qualifications Unit (email EnquireNQ@tnqab.to or Telephone 28136) if you like to discuss or suggest changes to the details of this unit.