



Australian Government

MARL5003A Apply basic principles of marine mechanics

Release 1

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Modification History

Release 1

This is the first release of this unit.

Unit Descriptor

This unit involves the skills and knowledge required to apply the basic principles of marine mechanics and to perform associated calculations needed to operate and maintain marine machinery.

Application of the Unit

This unit applies to the work of Marine Engineering Watchkeepers on commercial vessels greater than 750 kW and forms part of the requirements for the Certificate of Competency Marine Engineer Watchkeeper issued by the Australian Maritime Safety Authority (AMSA).

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Not applicable.

Employability Skills Information

This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.

Performance criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the evidence guide.

Elements and Performance Criteria

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|---|---|
| 1 Use vector diagrams to calculate the resultant and equilibrant of up to four coplanar forces | <ul style="list-style-type: none">1.1 Meaning of force as a vector, moment of a force, resultant and equilibrant are explained1.2 Forces using the triangle and polygon of forces are determined1.3 Moments and couples applied to beams and levers are explained1.4 Centroid of an area is calculated1.5 Centre of gravity of regular geometrical shapes is calculated1.6 Resultant and equilibrant of a system of concurrent coplanar-planer forces are calculated |
| 2 Solve problems involving friction | <ul style="list-style-type: none">2.1 Nature of friction and the laws of dry sliding friction are explained2.2 Influence of lubrication on bearings and plain surfaces is outlined2.3 Coefficient of friction is derived2.4 Laws of friction are applied to movement in a horizontal plane and the force to overcome friction on horizontal surfaces2.5 Effect of lubricating two surfaces in contact with each other is outlined |
| 3 Apply laws of motion | <ul style="list-style-type: none">3.1 Laws of motion are explained3.2 Velocity/time and acceleration/displacement graphs are sketched and adapted to derive the standard velocity formula for both linear and angular motion3.3 Formula and/or graphs are applied to solve problems of linear and angular velocity3.4 Linear motion is converted to angular motion and revolutions to radians |
| 4 Solve problems in dynamics related to marine machinery | <ul style="list-style-type: none">4.1 Relationship between torque, work, energy and power in marine engines and compressors is explained4.2 Conservation of energy theorem is used to calculate energy and power during linear and angular motion4.3 Meaning of momentum is explained4.4 Calculations are performed associated with the collision of rigid bodies |

- 4.5 Centrifugal force is distinguished from centripetal force
 - 4.6 Centrifugal and centripetal force in relation to marine machinery is calculated
- 5 **Determine efficiency of lifting and geared marine machinery**
 - 5.1 Velocity ratio, mechanical advantage and efficiency of *simple machines* is calculated
 - 5.2 Calculations are performed to solve problems related to the operation of simple machines
- 6 **Calculate stress and strain due to axial loads**
 - 6.1 Normal stress is distinguished from strain
 - 6.2 Hooke's Law for stress and strain is explained
 - 6.3 Meaning of elastic limit, ultimate tensile strength, yield stress, limit of proportionality and factor of safety is explained
 - 6.4 Normal stress and strain caused by axial loads is calculated
- 7 **Determine shear stress and strain in coupling bolts and simple bolted connections**
 - 7.1 Shear stress in simple bolted connections is determined
 - 7.2 Torque theory is applied to calculate shear stress in coupling bolts
- 8 **Determine stresses in thin walled pressure vessels**
 - 8.1 Factor of safety and joint efficiency factor for pressure vessels is calculated
 - 8.2 Hoop and longitudinal stress in thin walled pressure vessels is calculated

Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

Required Skills:

- Assess own work outcomes and maintain knowledge of current codes, standards, regulations and industry practices
- Explain basic principles of marine mechanics
- Identify and apply relevant mathematical formulas and techniques to solve basic problems related to marine mechanics
- Identify and interpret numerical and graphical information, and perform mathematical calculations to determine resultant and equilibrant of coplanar forces, linear and angular velocity, and hoop and longitudinal stress in thin walled pressure vessels
- Identify, collate and process information required to perform basic calculations related to marine mechanics
- Impart knowledge and ideas through verbal, written and visual means
- Read and interpret written information needed to perform basic calculations in marine mechanics
- Use calculators to perform mathematical calculations

Required Knowledge:

- Centre of gravity
- Conservation of energy theorem
- Factor of safety
- Force
- Joint efficiency factor
- Laws of motion
- Momentum
- Nature and laws of friction
- Pressure vessels
- Stress and strain
- Thin cylinder theory
- Types and uses of simple machines
- Work health and safety (WHS)/occupational health and safety (OHS) requirements and work practices

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, the required skills and knowledge, the range statement and the Assessment Guidelines for the Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- The evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the Elements, Performance Criteria, Required Skills, Required Knowledge and include:
- performing accurate and reliable calculations
- solving problems using appropriate laws and principles.

Context of and specific resources for assessment

Performance is demonstrated consistently over time and in a suitable range of contexts.

Resources for assessment include access to:

- industry-approved marine operations site where basic principles of marine mechanics can be applied
- diagrams, specifications and other information required for performing basic calculations related to marine mechanics
- technical reference library with current publications on basic marine mechanics
- tools, equipment and personal protective equipment currently used in industry
- relevant regulatory and equipment documentation that impacts on work activities
- range of relevant exercises, case studies and/or other simulated practical and knowledge assessments
- appropriate range of relevant operational situations in the workplace.

In both real and simulated environments, access is required to:

- relevant and appropriate materials and equipment
- applicable documentation including workplace procedures, regulations, codes of practice and operation manuals.

Method of assessment

Practical assessment must occur in an:

- appropriately simulated workplace environment and/or
- appropriate range of situations in the workplace.

A range of assessment methods should be used to assess practical skills and knowledge. The following examples are appropriate to this unit:

- direct observation of the candidate applying basic principles of marine mechanics
- direct observation of the candidate applying relevant WHS/OHS requirements and work practices.

Guidance information for

Holistic assessment with other units relevant to the industry

assessment

sector, workplace and job role is recommended.

In all cases where practical assessment is used it should be combined with targeted questioning to assess Required Knowledge.

Assessment processes and techniques must be appropriate to the language and literacy requirements of the work being performed and the capacity of the candidate.

Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below.

Simple machines may include:

- Hydraulic jack
- Pulley blocks
- Reduction gears
- Screw jack
- Single and double purchase crab winches
- Warwick screw
- Wheel and axle
- Worm driven chain blocks

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering