Australian Government

MARL6003A Apply intermediate principles of marine mechanics

Release 1

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MARL6003A Apply intermediate principles of marine mechanics

Modification History

Release 1
This is the first release of this unit.

Unit Descriptor

This unit involves the skills and knowledge required to apply intermediate 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 a Marine Engineer Class 2 on commercial vessels greater than 3000 kW and forms part of the requirements for the Certificate of Competency Marine Engineer Class 2 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.

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Elements and Performance Criteria

1 Apply principle of moments to determine forces in supports, connections, bearings and support systems	1.1 Equilibrium of solids is explained 1.2 Polygon of forces is applied to determine an unknown force 1.3 Principle of moments is applied to solve moments of any quantity 1.4 Resultant of a system of co-planer forces is calculated 1.5 Twisting moment due to engine crank mechanisms is calculated 1.6 Moments of areas and solids are calculated
2 Perform friction calculations	2.1 Laws of friction are applied to solve problems involving friction in inclined planes 2.2 Coefficient of friction is converted to angle of repose 2.3 Friction theory is applied to solve problems involving screw threads 2.4 Brake torque is analysed and problems are solved relating to work lost on brake shoes and brake discs
3 Solve motion problems	3.1 Linear velocity/time and acceleration/time graphs are applied to derive standard linear formula 3.2 Problems of linear and angular motion involving uniform acceleration and deceleration are solved 3.3 Marine engineering problems involving free falling bodies are solved
4 Solve problems using principle of momentum	4.1 Relationship between momentum and impulse is explained 4.2 Conservation of energy theory is applied to problems involving collision of perfectly elastic bodies

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5 Solve problems using principles of dynamics	5.1 Centripetal force is distinguished from centrifugal force
	5.2 Relationship between centripetal and centrifugal force and mass, angular velocity and radius is clarified
	5.3 Problems are solved involving centripetal and centrifugal forces
	5.4 Centripetal acceleration is distinguished from centrifugal force
	5.5 Out-of-balance forces on co-planer systems are calculated
	5.6 Bearing reactions in rotating shafts are determined
	5.7 Radius of gyration and moment of inertion when applied to rotating bodies is explained
	5.8 Centrifugal forces in ***governors*** are calculated
	5.9 Principles of dynamics are applied to solve problems involving rotating bodies, accelerating shafts, motors and flywheels
6 Calculate stresses and strains on components due to axial loading and restricted thermal expansion	6.1 Reduction in area and percentage elongation of tensile test specimens is calculated
	6.2 Stresses in composite bodies of dissimilar dimensions and dissimilar materials are calculated
	6.3 Problems involving thermal stress on components due to temperature change with free and restricted expansion are solved
7 Apply thin cylinder theory to determine stresses in pressure vessels	7.1 Stress on thin-shelled pressure vessels due to internal pressure is calculated
	7.2 Formula for calculating stress on thin-shelled pressure vessels to incorporate ***special conditions*** is modified

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8	**Apply torsion theory to calculate shear stress**	8.1	Torsion equation is applied to solve problems involving solid and hollow shafts
		8.2	Power transmitted in shafts and coupling bolts is calculated
		8.3	Torsion equation is applied to calculate stress and deflection in a close-coiled helical spring
		8.4	Power transmitted by shafts and couplings is calculated
9	**Solve problems involving fluids**	9.1	Variation of fluid pressure with depth is calculated
		9.2	Bernoulli's Theorem is used to solve problems of velocity, pressure and head in pipes and ducted systems
		9.3	Archimedes' Principle is used to solve problems related to floating vessels using real and apparent weight
10	**Apply beam theory to solve problems**	10.1	Reactions of a loaded beam are calculated
		10.2	Shear force and bending moment diagrams are constructed for simply supported and cantilever beams
		10.3	Shear force and bending moment diagrams for beams with concentrated and uniformly distributed loads are calculated
		10.4	Beam equation is applied to derive stresses in beams loaded with concentrated and uniformly distributed loads
		10.5	Beam equation is applied to calculate bending stresses

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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 solve problems related to fluids and stresses
- 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:

- Beam theory
- Conservation of energy theorem
- Factor of safety
- Fluids
- Forces:
  - balanced and unbalanced forces
  - centre of gravity
  - conditions for equilibrium
  - coplanar
  - definitions of matter, mass, weight, force, density and relative density
  - forces
  - moments of couples
  - parallelogram and triangle of forces
  - pressure
  - scalar and vector quantities
  - vector representation of forces
- Joint efficiency factor
- Laws of:
  - friction

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  - motion
- Momentum
- Motion:
  - action and reaction
  - force, velocity and acceleration
  - linear and angular motion
  - momentum
  - Newton’s laws of motion
- Pressure vessels
- Principle of moments
- Principles of dynamics
- Relationship between torque and power
- Stress and strain:
  - direct stress and strain
  - Hooke's law
  - load extension graphs
  - modulus of elasticity
  - shear stress and strain
- Thin cylinder theory
- Work health and safety (WHS)/occupational health and safety (OHS) requirements and work practices

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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: • making 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 intermediate principles of marine mechanics can be applied • diagrams, specifications and other information required for performing calculations related to marine mechanics • technical reference library with current publications on 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 intermediate principles of marine mechanics

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	• direct observation of the candidate applying relevant WHS/OHS requirements and work practices.
Guidance information for assessment	Holistic assessment with other units relevant to the industry 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.

Governors may include:	• Porter • Watt
Special conditions may include:	• Joint efficiencies • Safety factors

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering

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