



Australian Government

MARL6007A Apply advanced 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 advanced 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 1 on commercial vessels of unlimited propulsion power and forms part of the requirements for the Certificate of Competency Marine Engineer Class 1 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 Apply principle of statics to determine forces in structures, connections, support systems, and trusses in two and three dimensions | <ul style="list-style-type: none">1.1 Bow's notation is applied to solve problems related to trusses1.2 Individual loads are computed using method of sections1.3 Forces in three-dimensional structures are calculated |
| 2 Calculate friction torque in plate and cone clutches | <ul style="list-style-type: none">2.1 Laws of friction are applied to develop formulae, using uniform wear, to find the torque in a plate and cone clutch2.2 Laws of friction are applied to develop formulae, using uniform pressure, to find the torque in plate and cone clutches2.3 Power to overcome friction in plate and cone clutches using uniform wear and uniform pressure formulae is computed |
| 3 Calculate displacement, velocity and acceleration in cams, engine mechanisms and gear systems | <ul style="list-style-type: none">3.1 Velocity and acceleration diagrams are applied to illustrate relative velocity and acceleration3.2 Output of epicyclic gears is calculated by applying relative velocity and acceleration theory3.3 Inertia loads are calculated using piston velocity and acceleration equations |
| 4 Analyse forces and couples to balance reciprocating machinery | <ul style="list-style-type: none">4.1 How primary force balance is obtained is graphically illustrated4.2 Relationship between complete balance and dynamic balance is explained4.3 Reciprocating piston acceleration formula is applied to differentiate between primary and secondary forces4.4 Complete balance for a multicylinder reciprocating engine or machine is illustrated graphically using vector diagrams and computed analytically |

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| 5 Apply simple harmonic motion principles to solve problems in free and forced vibration | <ul style="list-style-type: none">5.1 Differences in the terms amplitude, frequency and period are explained5.2 Simple harmonic motion (SHM) equations are derived from the scotch yoke mechanism5.3 Equations for displacement, velocity, acceleration and frequency in SHM are developed5.4 Displacement, velocity, acceleration and frequency in SHM in a vibrating spring-mass system are determined5.5 Spring constant (k) for springs in series and parallel is calculated5.6 Forced vibration caused by an out-of-balance rotating mass is analysed to derive an expression for amplitude of forced vibration5.7 Dangers of resonance are explained5.8 Transmissibility factor to calculate frequency and spring rate are applied |
| 6 Calculate hoop stresses in rotating rings and stresses in compound bars | <ul style="list-style-type: none">6.1 How rotational stress is generated by centrifugal force is explained6.2 Formula for hoop stress in a rotating ring is applied to calculate hoop stress and/or limiting speed of rotation6.3 Stresses in compound bars subject to axial loads and/or temperature change are determined |
| 7 Apply strain energy and resilience theory to determine stresses caused by impact or suddenly applied loads | <ul style="list-style-type: none">7.1 Equation is derived to calculate strain energy in a deformed material7.2 Stress in a material due to impact or dynamic loads is determined using energy equation7.3 Equation to calculate stress caused by suddenly applied loads is derived |

8 Calculate beam deflection

8.1 Macaulay's method is applied to calculate beam deflection

8.2 Deflection of cantilever and simply supported beams is calculated using standard deflection formulae for **different loads**

9 Apply Euler's formula to find buckling load of a column

9.1 Effective length of a column with various end restraints is determined

9.2 Slenderness ratio is applied to determine the strength of columns

9.3 Relationship between slenderness ratio and buckling is explained

9.4 How buckling load for a slender column is applied (including a factor of safety) is explained

10 Calculate stresses

10.1 How to combine stress formula and calculate stress with combined loading is explained

10.2 Superposition is used to describe stress due to combined axial and bending stress

10.3 Mohr's Circle is employed to illustrate normal and shear stress

10.4 Principal stress formulae are applied to explain how maximum combined normal and shear stress can be obtained

10.5 Principal stress equation is applied to calculate maximum combined shear and normal stress

11 Apply thick shell formulae

11.1 Tangential stress distribution caused by internal and external pressure is analysed

11.2 Lamé's theorem is applied to describe stress in thick cylinders due to internal and external pressure

12 Apply continuity equation to determine changes in fluid velocity

- 12.1 Conservation of energy theory is applied to calculate pressure, head and velocity of fluids flowing through orifices
- 12.2 Volumetric and mass flow through a venturi meter is calculated
- 12.3 Forces exerted by flowing fluids either free (jet) or contained are determined, including coefficients of velocity, contraction of area and discharge

13 Determine changes in fluid flows through pipe systems and centrifugal pumps

- 13.1 Difference between steady and unsteady flow is clarified
- 13.2 Viscosity of fluids is analysed and difference between dynamic and kinematic viscosity is explained
- 13.3 Significance of Reynolds number in fluid mechanics is explained
- 13.4 Importance of critical Reynolds number is explained
- 13.5 Flow losses in pipes and fittings are calculated
- 13.6 Changes of velocity of liquids in a centrifugal pump are analysed and entry and exit vane angles are determined

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 advanced principles of marine mechanics
- Identify and apply relevant mathematical formulas and techniques to solve advanced problems related to marine mechanics
- Identify and interpret numerical and graphical information, and perform complex mathematical calculations such as determining hoop stresses in rotating rings and stresses in compound bars
- Identify, collate and process information required to perform complex calculations related to marine mechanics
- Impart knowledge and ideas through verbal, written and visual means
- Read and interpret written information needed to perform complex calculations in marine mechanics
- Use calculators to perform complex mathematical calculations

Required Knowledge:

- Angular and linear motion
- Centre of gravity
- Conservation of energy theorem
- Factor of safety
- Force
- Inertia force
- Joint efficiency factor
- Laws of motion
- Momentum
- Nature and laws of friction
- Polygon of forces
- Pressure vessels
- Reactions
- Simple harmonic motion
- Stress and strain
- Thin cylinder theory
- Turning moment
- Vector diagrams
- 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:

- 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 advanced principles of marine mechanics can be applied
- diagrams, specifications and other information required for performing advance calculations related to marine mechanics
- technical reference library with current publications on advanced 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 advanced principles of marine mechanics
- 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.

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| Dangers may include: | <ul style="list-style-type: none">• Catastrophic failure due to physical limitations of machines being exceeded as determined by their susceptibility and resistance to vibrations• Violent swaying motions |
| Different loads may include: | <ul style="list-style-type: none">• Concentrated• Distributed• Combined |

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering