



**Australian Government**

# **MARL016 Apply intermediate principles of marine mechanics**

**Release: 1**

# MARL016 Apply intermediate principles of marine mechanics

## Modification History

Release 1. New unit of competency.

## Application

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.

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).

No licensing, legislative or certification requirements apply to this unit at the time of publication.

## Pre-requisite Unit

Not applicable.

## Competency Field

L – Marine Engineering

## Unit Sector

Not applicable.

## Elements and Performance Criteria

Elements describe the essential outcomes.

Performance criteria describe the performance needed to demonstrate achievement of the element.

|                                                                                                                |     |                                                                  |
|----------------------------------------------------------------------------------------------------------------|-----|------------------------------------------------------------------|
| <b>1 Apply principle of moments to determine forces in supports, connections, bearings and support systems</b> | 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                                                                                |
| <b>2 Perform friction calculations</b>               | 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                     |
| <b>3 Solve motion problems</b>                       | 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                                                      |
| <b>4 Solve problems using principle of momentum</b>  | 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                      |
| <b>5 Solve problems using principles of dynamics</b> | 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 inertia 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 |

|                                                                                                             |      |                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------|
| <b>6 Calculate stresses and strains on components due to axial loading and restricted thermal expansion</b> | 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 |
| <b>7 Apply thin cylinder theory to determine stresses in pressure vessels</b>                               | 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           |
| <b>8 Apply torsion theory to calculate shear stress</b>                                                     | 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                                                                 |
| <b>9 Solve problems involving fluids</b>                                                                    | 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              |
| <b>10 Apply beam theory to solve problems</b>                                                               | 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                                                                  |

## Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

## Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Governors must include:

- porter
- watt

Special conditions must include:

- joint efficiencies
- safety factors

## Unit Mapping Information

This unit replaces and is equivalent to MARL6003A Apply intermediate principles of marine mechanics.

## Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=772efb7b-4cce-47fe-9bbd-ee3b1d1eb4c2>

# **Assessment Requirements for MARL016 Apply intermediate principles of marine mechanics**

## **Modification History**

Release 1. New unit of competency.

## **Performance Evidence**

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions on at least one occasion and include:

- applying relevant work health and safety/occupational health and safety (WHS/OHS) requirements and work practices
- assessing own work outcomes and maintaining knowledge of current codes, standards, regulations and industry practices
- identifying and applying relevant mathematical formulas and techniques to solve basic problems related to marine mechanics
- identifying and interpreting numerical and graphical information, and performing mathematical calculations to solve problems related to fluids and stresses
- identifying, collating and processing information required to perform basic calculations related to marine mechanics
- imparting knowledge and ideas through verbal, written and visual means
- reading and interpreting written information needed to perform basic calculations in marine mechanics
- solving problems using appropriate laws and principles
- using calculators to perform mathematical calculations.

## **Knowledge Evidence**

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions and include knowledge of:

- basic principles of marine mechanics
- 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
  - 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
- WHS/OHS requirements and work practices.

## Assessment Conditions

Assessors must satisfy National Vocational Education and Training Regulator (NVR)/Australian Quality Training Framework (AQTF) assessor requirements.

Assessment must satisfy the National Vocational Education and Training Regulator (NVR)/Australian Quality Training Framework (AQTF) standards.

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

Assessment must occur in workplace operational situations or where these are not available, in simulated workplace operational situations or an industry-approved marine operations site that replicates workplace conditions, where intermediate principles of marine mechanics can be applied.

Resources for assessment include access to:

- applicable and relevant documentation including workplace procedures, regulations, codes of practice and operation manuals
- appropriate range of relevant operational situations in the workplace
- 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.

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

## Links

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