



Australian Government

MARL020 Apply advanced principles of marine mechanics

Release: 1

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Modification History

Not applicable.

Application

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.

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).

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.
1 Apply principle of statics to determine forces in structures, connections, support systems, and trusses in two and three dimensions	1.1 Bows notation is applied to solve problems related to trusses
	1.2 Individual loads are computed using method of sections
	1.3 Forces in three-dimensional structures are calculated
2 Calculate friction torque in plate and	2.1 Laws of friction are applied to develop formulae, using uniform wear, to find the torque in a plate and cone clutch

cone clutches	2.2	Laws of friction are applied to develop formulae, using uniform pressure, to find the torque in plate and cone clutches
	2.3	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	3.1	Velocity and acceleration diagrams are applied to illustrate relative velocity and acceleration
	3.2	Output of epicyclic gears is calculated by applying relative velocity and acceleration theory
	3.3	Inertia loads are calculated using piston velocity and acceleration equations
4 Analyse forces and couples to balance reciprocating machinery	4.1	How primary force balance is obtained is graphically illustrated
	4.2	Relationship between complete balance and dynamic balance is explained
	4.3	Reciprocating piston acceleration formula is applied to differentiate between primary and secondary forces
	4.4	Complete balance for a multicylinder reciprocating engine or machine is illustrated graphically using vector diagrams and computed analytically
5 Apply simple harmonic motion principles to solve problems in free and forced vibration	5.1	Differences in the terms amplitude, frequency and period are explained
	5.2	Simple harmonic motion (SHM) equations are derived from the scotch yoke mechanism
	5.3	Equations for displacement, velocity, acceleration and frequency in SHM are developed
	5.4	Displacement, velocity, acceleration and frequency in SHM in a vibrating spring-mass system are determined
	5.5	Spring constant (k) for springs in series and parallel is calculated
	5.6	Forced vibration caused by an out-of-balance rotating mass is analysed to derive an expression for amplitude of forced vibration
	5.7	Dangers of resonance are explained

6 Calculate hoop stresses in rotating rings and stresses in compound bars	6.1	How rotational stress is generated by centrifugal force is explained
	6.2	Formula for hoop stress in a rotating ring is applied to calculate hoop stress and/or limiting speed of rotation
	6.3	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	7.1	Equation is derived to calculate strain energy in a deformed material
	7.2	Stress in a material due to impact or dynamic loads is determined using energy equation
	7.3	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
11 Apply thick shell	11.1	Tangential stress distribution caused by internal and external

formulae		pressure is analysed
	11.2	Lame'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

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.

Dangers include one or more of the following:

- catastrophic failure due to physical limitations of machines being exceeded as determined by their susceptibility and resistance to vibrations
- violent swaying motions

Different loads include one or more of the following:

- combined
- concentrated
- distributed

Unit Mapping Information

This unit replaces and is equivalent to MARL6007A Apply advanced 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 MARL020 Apply advanced principles of marine mechanics

Modification History

Not applicable.

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 advanced problems related to marine mechanics
- identifying and interpreting numerical and graphical information, and performing complex mathematical calculations such as determining hoop stresses in rotating rings and stresses in compound bars
- identifying, collating and processing information required to perform complex calculations related to marine mechanics
- imparting knowledge and ideas through verbal, written and visual means
- reading and interpreting written information needed to perform complex calculations in marine mechanics
- solving problems using appropriate laws and principles
- using calculators to perform accurate, reliable and complex 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:

- advanced principles of marine mechanics
- angular and linear motion
- Bows notation
- centre of gravity
- conservation of energy theorem
- factor of safety
- force

- inertia force
- joint efficiency factor
- laws of friction
- 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
- 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 advanced principles of marine mechanics can be applied

Resources for assessment include access to:

- applicable documentation including workplace procedures, regulations, codes of practice and operation manuals
- diagrams, specifications and other information required for performing advance calculations related to marine mechanics
- relevant regulatory and equipment documentation that impacts on work activities
- technical reference library with current publications on advanced marine mechanics
- tools, equipment, materials and personal protective equipment currently used in industry.

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

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