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