Australian Government

MARL6004A Apply intermediate principles of naval architecture

Release 1

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MARL6004A Apply intermediate principles of naval architecture

Modification History

Release 1
This is the first release of this unit.

Unit Descriptor

This unit involves the skills and knowledge required to perform intermediate calculations related to the seaworthiness of commercial vessels, including those dealing with vessel stability, fuel consumption, power and symmetrical flooding.

Application of the Unit

This unit applies to the work of a Marine Engineers Class 2 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.

Elements and Performance Criteria

1 Calculate shipboard areas, volumes and displacement	1.1	Simpson's Rules are applied to find typical and non-conforming ***shipboard areas***
	1.2	Simpson's Rules are applied to calculate water plane areas or transverse sectional areas to determine underwater volumes
	1.3	Simpson's Rules are applied to immersed tonnes per centimetre values to determine displacement
	1.4	Tonnes per centimetre is applied to determine change in mean draught due to addition or removal of mass
2 Calculate coefficients of form and changes in draught associated with fluid density	2.1	Application of ***coefficients of form*** are identified and explained
	2.2	Problems are solved involving coefficients of form
	2.3	Impact of hull modification on hull form coefficients is explained
	2.4	Problems of coefficients of form are solved following change in length by mid body insertion/removal
	2.5	Relationship between underwater volume/draught and fluid density is explained
	2.6	Application of freeboard markings for Load Line Rules is explained
	2.7	Density correction formula is defined
	2.8	Change in mean draught due to change in density is calculated
3 Solve stability problems	3.1	Effects of adding, removing and transferring mass on board or from a vessel are explained
	3.2	Calculations are performed to solve problems involving suspended masses
	3.3	Positive, neutral and negative stability are distinguish from each other
	3.4	How centre of gravity is calculated for redistribution, addition and/or removal of masses is explained, including the use of derricks
	3.5	Problems are solved involving vertical and horizontal movement of masses to calculate KG and GM for typical vessel loaded conditions, together with true shift in vessel centre of gravity between specified conditions and small angle transverse stability
	3.6	Vessel righting moment and GZ are explained

	3.7	Calculations are performed to solve problems of small angle transverse stability
	3.8	Purpose of an Inclining Experiment is explained
	3.9	Formula for determining initial stability characteristics is applied
	3.10	Calculations are performed to solve problems using Inclining Experiments
4 Calculate loss of transverse stability due to fluid free surface	4.1	Principles of liquid free surface are explained
	4.2	Principles of metacentric height are explained
	4.3	Centre of gravity solid is distinguished from centre of gravity fluid
	4.4	Application of the second moment of area using parallel axis theorem to obtain free surface moment of inertia and use of density correction between vessel and free surface fluids is explained
	4.5	Calculations are performed to solve problems of liquid free surface for simple compartments, including correction for free surface on metacentric height [GM] and fluid mass on centre of gravity [KG]
5 Calculate centroids and solve problems of hydrostatics	5.1	Importance of area and volume centroids and methods of determining KG, LCF, LCB and bulkhead area centroids is explained
	5.2	Calculations are performed to solve problems related to area and volume centroids
	5.3	Methods of calculating pressures and loads on typical tank structures for different filling rates, accidental flooding or tank testing are explained
	5.4	Use of flat panel stiffeners and shear force reactions applicable to vertical bulkheads is explained
	5.5	Calculations are performed to solve problems in hydrostatics relating to pressure and loads on ship structures, including bulkheads, stiffeners and shear forces
6 Solve problems involving propellers and powering	6.1	Factors that influence the ***speed of advance*** are explained
	6.2	Calculations are performed to solve problems of single screw vessels
	6.3	Relationships between propulsive coefficient, quasi propulsive coefficient and ***related powers*** together with typical values of losses

		for transmission, hull and propeller are explained
	6.4	Components of ***hull resistance*** are explained
	6.5	Calculations are performed to show impact of resistance augmentation and thrust deduction factors on powering of full size vessels
	6.6	Causes, effects and methods of reducing cavitation are explained
7 Calculate voyage and daily fuel consumptions	7.1	Admiralty coefficient for fuel consumption is stated taking account of values for ship speed, shaft power and displacement
	7.2	Vessel fuel consumption is calculated using admiralty coefficient
	7.3	Calculations are performed to show relationship between fuel consumption and displacement
	7.4	Calculations are performed to show relationship between daily fuel consumption and speed
	7.5	Calculations are performed to show relationship between voyage consumption, speed and distance travelled
	7.6	Voyage and daily fuel consumption are calculated taking into account propulsion, domestic loads and fuel reserve requirements
8 Solve problems related to symmetrical flooding	8.1	Volume lost-volume gained relationship for flooded compartments is explained
	8.2	Modified volume lost by compartment subdivision is explained using a horizontal flat
	8.3	Modified volume lost by compartment permeability is explained, including consideration of cargo stowage factor and relative density details
	8.4	Problems of symmetrical flooding of simple box-shaped and standard hull forms involving flooding above and below horizontal subdivisions and different permeabilities are solved

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 intermediate principles of naval architecture
- Identify and apply relevant mathematical formulas and techniques to solve problems related to speed, fuel consumption and stability of commercial vessels
- Identify and interpret numerical and graphical information, and perform mathematical calculations related to shipboard areas and volumes, vessel displacement, ship dimensions, centre of gravity, vessel speed and fuel consumption
- Identify, collate and process information required to perform calculations related to speed, fuel consumption and stability of commercial vessels
- Impart knowledge and ideas through oral, written and visual means
- Read and interpret written information needed to perform calculations related to the seaworthiness of commercial vessels
- Use calculators in performing mathematical calculations

Required Knowledge:

- Admiralty and fuel coefficients
- Buoyancy
- Centre of gravity:
  - KG, VCG and LCG
  - calculations
- Density correction formula
- Displacement
- Draught alterations
- Fuel consumption calculations
- Hydrostatic pressure
- Metacentre
- Principle of displacement
- Propellers and powering
- Ship:
  - displacement
  - measurements
  - stability
  - stability calculations

- Shipboard areas
- Shipboard volumes
- Simpson's Rules
- Structural members of a ship and the proper names of various parts
- Symmetrical flooding
- Tonnes per centimetre immersion (TPC)
- Traverse stability
- Trim and stress tables, diagrams and stress calculating equipment
- Vessel speed calculations
- Watertight integrity
- 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 intermediate principles of naval architecture can be applied
- vessel diagrams and specifications and other information required for mathematical calculations related to shipboard areas and volumes, vessel displacement, centre of gravity, vessel speed, fuel consumption, vessel stability, power and symmetrical flooding
- technical reference library with current publications on naval architecture
- 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 naval architecture
- 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.

Shipboard areas may include:	• Bulkheads • Elemental areas • Water planes
Coefficients of form may include:	• Block coefficient • Midship section area coefficient • Prismatic coefficient • Waterplane area coefficient
Centre of gravity refers to:	• Centre of gravity (KG) • Longitundal centre of gravity (LCG) • Vertical centre of gravity (VCG)
Speed of advance includes:	• Apparent and true slips • Taylor Wake Fraction • Theoretical, apparent and true speeds • Wake speed
Related powers includes:	• Delivered • Effective • Indicated • Shaft • Thrust
Hull resistance includes:	• Frictional • Residuary • Total

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering