Australian Government

MARL5004A Apply basic principles of naval architecture

Release 1

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MARL5004A Apply basic 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 basic calculations related to the seaworthiness of commercial vessels, including those dealing with watertight integrity and vessel stability.

Application of the Unit

This unit applies to the work of Marine Engineering Watchkeepers on commercial vessels greater than 750 kW and forms part of the requirements for the Certificate of Competency Marine Engineer Watchkeeper 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 and volumes	1.1 Basic principle structural members of ship and proper names of various parts are detailed
	1.2 Simpson's Rules are applied to calculate ***shipboard areas***
	1.3 Simpson's Rules are applied to calculate ***shipboard volumes***
2 Calculate vessel displacement	2.1 Tonnes per centimetre (TPC) values and Simpson's Rules are applied to calculate vessel displacement
	2.2 Calculations are performed using TPC values and Simpson's Rules to solve ***problems related to vessel displacement***
3 Calculate ship dimensions	3.1 Ship form dimensions are calculated using ***coefficients for areas***
	3.2 Ship form ***coefficients for underwater volumes*** are calculated
	3.3 Influence of common hull modifications on hull form coefficients is explained
	3.4 Calculations are performed to solve problems of ship form coefficients following change to vessel length resulting from mid body insertion or removal
4 Explain position of centre of gravity of vessel in relation to its keel and midships	4.1 ***Centre of gravity*** calculations for a vessel are performed
	4.2 How centre of gravity changes with redistribution, addition and/or removal of ***mass*** is explained
	4.3 How addition, removal or transfer of mass may cause overturning moments is identified
	4.4 Problems are solved involving addition, removal and vertical movement of mass by performing centre of gravity calculations for typical vessel loaded conditions
	4.5 Calculations are performed using results from inclining experiments to obtain initial stability characteristics
5 Explain effects of water density and flooding of mid-length compartment on vessel draft	5.1 Relationship between changes in underwater volume and changes in water density is outlined
	5.2 Fresh water allowance of a vessel is determined
	5.3 Change in mean draft for vessel movement between waters of different densities is calculated
	5.4 Volume lost-volume gained relationship for flooded compartments is

		explained
	5.5	Calculations are performed to solve problems of mid-length compartment flooding in simple box-shaped hull forms
	5.6	Fundamental actions to be taken in the event of partial loss of intact buoyancy are identified
6 Perform calculations related to propellers and vessel speed	6.1	Relationship between propellers and vessel speed is explained
	6.2	Problems related to vessel speed and propellers are solved by calculating theoretical, apparent and true speeds, apparent and true slips, wake speed and Taylor wake fraction
	6.3	Impact of fouling on vessel hull and propeller is outlined
7 Calculate voyage and daily fuel consumptions	7.1	Fuel consumption is determined by applying admiralty coefficient for fuel consumption taking account of ship speed, shaft power and displacement
	7.2	Calculations are performed to solve problems of vessel fuel consumption taking account of ship speed, shaft power and displacement
	7.3	Impact of fouling on vessel fuel consumption is explained
8 Calculate pressures and loads on surfaces due to hydrostatics	8.1	Standard formula for hydrostatic pressure is defined
	8.2	Hydrostatic load on vertical and horizontal surfaces is calculated
	8.3	Method of calculating loads on typical tank structures for different ***filling rates*** is explained

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 basic principles of naval architecture
- Identify and apply relevant mathematical formulas and techniques to solve basic 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, fuel consumption and hydrostatic pressure
- Identify, collate and process information required to perform calculations related to speed, fuel consumption and stability of commercial vessels
- Impart knowledge and ideas through verbal, written and visual means
- Read and interpret written information needed to perform calculations related to the seaworthiness of commercial vessels
- Use calculators to perform mathematical calculations

Required Knowledge:

- Basic structural members of a ship and the proper names of the various parts
- Buoyancy
- Centre of gravity:
  - KG, VCG and LCG
  - calculations
- Density correction formula
- Fuel consumption calculations
- Hydrostatic pressure
- Principle of displacement
- Ship:
  - stability
  - stability calculations
  - measurements
  - displacement
- Shipboard:
  - areas
  - volumes
- Simpson's Rules

- TPC immersion
- 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: • performing 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 basic 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, ship dimensions, centre of gravity, vessel speed, fuel consumption and hydrostatic pressure • technical reference library with current publications on basic 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 where basic 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
Shipboard volumes may include:	• Transverse sectional areas • Water plane areas
Problems related to vessel displacement may include:	• Addition of mass • Removal of mass
Coefficients for areas may include:	• Midships (CM) • Waterplane (CW)
Coefficients for underwater volumes may include:	• Block (Cb) • Prismatic (Cp)
Centre of gravity may include:	• Centre of gravity [KG] • Longitundal centre of gravity [LCG] • Vertical centre of gravity [VCG]
Mass may include:	• Ballast • Cargo • Fuel • Passengers
Filling rates may include:	• Accidental flooding • Tank testing

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering