



Australian Government

MARL045 Apply basic principles of naval architecture

Release: 1

MARL045 Apply basic principles of naval architecture

Modification History

Release 1. This is the first release of this unit of competency in the MAR Maritime Training Package.

Application

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.

This unit applies to people working in the maritime industry in the capacity of:

- Electro-Technical Officer (STCW Electro-Technical Officer Unlimited)
- Engineer Class 3 Near Coastal
- Engineer Watchkeeper (STCW Engineer Watchkeeper Unlimited).

Licensing/Regulatory Information

Legislative and regulatory requirements are applicable to this unit.

- Regulatory requirements include STCW International Maritime Organization (IMO) model course competencies and areas of knowledge, understanding and proficiency, together with the estimated total hours required for lectures and practical exercises. Teaching staff should note that timings are suggestions only and should be adapted to suit individual groups of trainees depending on their experience, ability, equipment and staff available for training.

Near Coastal Qualifications:

- This unit is one of the requirements to obtain Australian Maritime Safety Authority (AMSA) certification as an Engineer Class 3 Near Coastal as defined in the Marine Order 505 (Certificates of competency - National Law) 2013.

Blue Waters Qualifications:

- This unit is one of the requirements to obtain Australian Maritime Safety Authority (AMSA) certification as an Electro-Technical Officer (STCW Electro-Technical Officer Unlimited) or Engineer Watchkeeper (STCW Engineer Watchkeeper Unlimited) and to meet regulatory requirements this unit must be delivered consistent with Marine Orders and with the relevant sections of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW).

Pre-requisite Unit

Not applicable.

Competency Field

L - Engineering

Unit Sector

Not applicable.

Elements and Performance Criteria

ELEMENTS

Elements describe the essential outcomes.

1 Calculate shipboard areas and volumes

2 Calculate vessel displacement

3 Calculate ship dimensions

PERFORMANCE CRITERIA

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

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| 1.1 | Basic principal 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 |
| 2.1 | 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 |
| 3.1 | 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 |

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| 4 Explain position of centre of gravity (CG) of vessel in relation to its keel and midships | 4.1 | CG calculations for a vessel are performed |
| | 4.2 | How CG 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 CG 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 | Freshwater 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 |

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| 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 |

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.

Unit Mapping Information

This unit replaces and is equivalent to MARL002 Apply basic principles of naval architecture.

Links

Companion Volume implementation guide can be found in VetNet -

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

Assessment Requirements for MARL045 Apply basic principles of naval architecture

Modification History

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Performance Evidence

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

- assessing own work outcomes and maintaining knowledge of current codes, standards, regulations and industry practices
- drawing load line mark and the load lines for a ship of a given summer moulded draught, displacement and tonnes per centimetre (TPC) immersion in saltwater
- explaining basic principles of naval architecture
- identifying actions to be taken in the event of partial loss of intake buoyancy
- identifying and applying relevant mathematical formulas and techniques to solve basic problems related to speed, fuel consumption and stability of commercial vessels
- identifying and interpreting numerical and graphical information, and performing mathematical calculations related to shipboard areas and volumes, vessel displacement, angle of loll, ship dimensions, centre of gravity (CG), vessel speed, fuel consumption and hydrostatic pressure
- identifying, collating and processing information required to perform calculations related to speed, fuel consumption and stability of commercial vessels
- imparting knowledge and ideas through verbal, written and visual means
- performing accurate and reliable calculations
- reading and interpreting written information needed to perform calculations related to the seaworthiness of commercial vessels
- 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 and performance criteria and include knowledge of:

- basic structural members of a ship and the proper names of the various parts
- buoyancy
- calculations
- CG, longitudinal centre of gravity (LCG) and vertical centre of gravity (VCG)
- coefficients for areas, including:

- midships (CM)
- waterplane (CW)
- coefficients for underwater volumes, including:
 - block (Cb)
 - prismatic (Cp)
- curves of statistical stability
- density correction formula
- effects of slack tanks
- filling rates, including:
 - accidental flooding
 - tank testing
- fuel consumption calculations
- hydrostatic pressure
- movement of CG
- principle of displacement
- problems related to vessel displacement, including:
 - addition of mass
 - removal of mass
- ship:
 - displacement
 - measurements
 - stability calculations
 - stability including statistical and initial
 - types, including:
 - bulk carriers
 - combination carriers
 - container
 - general cargo
 - oil, chemical and gas tankers
 - passenger
 - roll-on and roll-off (ro-ro)
- ship construction, including:
 - bow and stern regions
 - fitting
 - hull structure
 - load line and draught marks, including:
 - chart of zones, areas and seasonal periods used to find the applicable load line
 - definition of 'freeboard'
 - definition of 'assigned summer freeboard'
 - freeboard, measured from the upper edge of the deck line to the water on each side,

- including checks that the ship is within its permitted limits of loading
- height of sill varies between different types of ships based on load line rules
- how to read draughts
- items in the conditions of assignment of freeboard
- load line mark and the load lines for a ship of a given summer moulded draught, displacement and TPC immersion in saltwater
- where the deck line is marked
- rudders and propellers
- ship dimensions and form
- ship stresses, including:
 - calculations for pressure at any depth below the liquid surface, given the density of the liquid
 - causes of corrosion onboard
 - ‘hogging’ and ‘sagging’ and distinguishing between them
 - hogging and sagging stresses caused by sea state
 - hogging and sagging stresses resulting in tensile or compressive forces in the deck and bottom structure
 - liquid pressure loading on the ship’s hull
 - loading conditions which give rise to hogging and sagging stresses
 - methods that are being used to minimise the effects of corrosion
 - ‘pounding’ or ‘slamming’ and which part of the ship is affected
 - stress set up by liquid sloshing in a partly filled tank
 - racking stress and it causes
 - shear force and bending moments
 - stresses caused by localised loading
 - water pressure loads on ship’s hull
- shipboard:
 - areas, including:
 - bulkheads/elemental areas
 - water planes
 - mass, including:
 - ballast
 - cargo
 - fuel
 - passengers
 - volumes, including:
 - transverse sectional areas
 - water plane areas
- Simpson’s Rules
- TPC immersion

- trim and stress tables, diagrams and stress calculating equipment
- vessel speed calculations
- watertight integrity.

Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

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.

Practical assessment must occur in a workplace, or realistic simulated workplace, under the normal range of workplace conditions.

Simulations and scenarios may be used where situations cannot be provided in the workplace or may occur only rarely, in particular for situations relating to emergency procedures and adverse weather conditions where assessment would be unsafe, impractical or may lead to environmental damage.

Resources for assessment must include access to:

- applicable documentation, such as legislation, regulations, codes of practice, workplace procedures and operational manuals
- tools, equipment, machinery, materials and relevant personal protective equipment (PPE) currently used in industry.

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