



Australian Government

Department of Education, Employment and Workplace Relations

TDMMA1007B CONTROL TRIM, STABILITY AND STRESS

Revision Number: 1

TDMMA1007B CONTROL TRIM, STABILITY AND STRESS

Modification History

Not applicable.

Unit Descriptor

UNIT DESCRIPTOR:

This unit involves the skills and knowledge required to control the trim and stability of a commercial vessel and the stresses on its hull and structure both under normal operating conditions and in the event of flooding following damage to one or more compartments.

Application of the Unit

Application of the unit	The unit has application in qualifications for Marine Engineer Class 1, a Marine Engineer Class 2 and a Master or Chief Mate on a vessel of 500 gross tonnage or more operating in international waters, i.e. Advanced Diploma of Transport&Distribution(Marine Engineering Class 1), Advanced Diploma of Transport&Distribution(Marine Engineering Class 2) and Advanced Diploma of Transport&Distribution(Maritime Operations - Master Unlimited).
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Licensing/Regulatory Information

Licensing/legislative requirements	The unit is consistent with the relevant sections of STCW 95 and Marine Orders under the Australian Navigation Act 1912, describing requirements for a Master or Chief Mate on a vessel of 500 gross tonnage or more operating in international waters.
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Pre-Requisites

Not applicable.

Employability Skills Information

Not applicable.

Elements and Performance Criteria Pre-Content

<i>Elements describe the essential outcomes of a unit of competency.</i>	<i>Performance Criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the Evidence Guide.</i>
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Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1 Control the trim and stability of a vessel under normal operating conditions	<ul style="list-style-type: none"> a Stability analysis and weight distribution planning are conducted at a time, frequency and scope appropriate to the proposed nature of the voyage or vessel operation b Weight distribution is organised to maintain the vessel within acceptable stability limits for anticipated operation situations likely to be experienced during the voyage c Calculations are made to determine the draught and centre of gravity of the vessel after adding, removing or shifting weight d Trim, draughts and list of the vessel are controlled as required to ensure they are suitable to progress all anticipated vessel operations
2 Control the trim and stability of a vessel in the event of damage and consequent flooding	<ul style="list-style-type: none"> a Damage to the vessel and the nature of flooding of compartments is promptly assessed b The effects upon vessel stability of flooded and flooding compartments is evaluated

ELEMENT	PERFORMANCE CRITERIA
2 Control the trim and stability of a vessel in the event of damage and consequent flooding (continued)	<ul style="list-style-type: none"> c A suitably strategy for maintaining or restoring trim and stability is devised d Where stress limits of a vessel are unavoidably exceeded as a consequence of damage and/or flooding, appropriate action is initiated to ensure the safety of shipboard personnel, including where necessary abandoning the vessel
3 Manage the stress conditions of the vessel	<ul style="list-style-type: none"> a Stress limits of vessel are assessed in accordance with maritime principles and vessel manufacturer's specifications b Stability of vessel is monitored at a frequency and scope relevant to the nature and speed of vessel operations or emergency and is sufficient to enable stress and stability to be maintained within acceptable limits at all times c Appropriate action is taken promptly where weight distribution has or could exceed acceptable safety limits to ensure that the safety of the vessel and its passengers, crew and load is maximised

Required Skills and Knowledge

REQUIRED KNOWLEDGE

This describes the knowledge required for this unit.

- 1 Relevant sections of the IMO Conventions and Codes and AMSA Marine Orders
- 2 Relevant OH&S legislation, codes of practice, policies and procedures
- 3 Theory and calculations of vessel stability and dynamics, including:
 - i computation of hydrostatic stability data of a vessel
 - ii calculation of a vessel's centre of gravity, centre of buoyancy and metacentre
 - iii calculation of the transverse and longitudinal stability using hydrostatic data
 - iv calculation of the moment of statical stability at small angles of heel
 - v determination of the centre of gravity of a vessel using an inclining experiment and effect of suspended weights
 - vi determining the required correction for the height of centre of gravity (kg) for the free surface effect
 - vii determination of the values of the righting lever and construction of righting lever curves
 - viii calculations for change of draught, trim and heel when entering different water densities and due to bilging of compartments
 - ix changes to draught, trim and heel due to adding or removing fuel, ballast or cargo
 - x displacement, wetted surface, form coefficients, tonne per centimetre immersion, application of Simpson's rules to first and second moments of area, centroids and centres of pressure
- 4 Potential problems related to the control of trim and stability for vessels of 500 gross tonnage or more and appropriate action and solutions, including:
 - i free surface of a liquid
 - ii shift of cargo
 - iii wind heel
 - iv handling of heavy weights
 - v excessive trim
 - vi large swell conditions
 - vii dry docking
 - viii grounding

REQUIRED KNOWLEDGE

- 5 Principles of synchronous rolling and methods for its control, including an understanding of the effect on the rolling period of a vessel due to the radius of gyration
- 6 Causes and repercussions of a heeling vessel
- 7 Principal features of the structure of a vessel
- 8 Properties and application of materials used in vessel construction
- 9 Construction, layout and subdivision requirements of a typical vessel, including an understanding of freeboard and bulkhead deck, watertight compartments, weathertight compartments, the bulkhead of the vessel and collision bulkhead
- 10 Typical construction features, stress characteristics, forces on vessels under various conditions or vessels of 500 gross tonnage or more (in the case of masters), or 3,000 kW propulsion power (in the case of engineers)
- 11 The principal stresses which act on the structure of a vessel, including panting and pounding
- 12 Steps involved interpreting and analysing a vessel's dynamic stability and comparing it against the IMO's minimum stability criteria
- 13 Basic procedures and precautions for the repair and maintenance of a vessel
- 14 Effects of density of sea water on the draught and freeboard of a vessel
- 15 Features of the load-line and draught marks of a vessel and procedures for carrying out related calculations
- 16 Procedures for calculating the required load distribution to achieve the desired trim
- 17 Typical problems related to the control of trim and stability for vessels of 500 gross tonnage or more (in the case of masters), or 3,000 kW propulsion power (in the case of engineers) and appropriate action and solutions, including:
 - i problems concerning the strength of structural members to resist liquid pressure and loading due to a head of liquid
 - ii problems involving shearing force and bending moments of a loaded vessel in still water
- 18 Simple treatment of vibration
- 19 Bilge and ballast systems

- 9 Construction, layout and subdivision requirements of a typical vessel, including an understanding of freeboard and bulkhead deck, watertight compartments, weathertight compartments, the bulkhead of the vessel and collision bulkhead
- 20 Levelling arrangements for damaged side compartments

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REQUIRED SKILLS

This describes the skills required for this unit.

- 1 Communicate effectively with other personnel when determining and maintaining a vessel's stability and trim
- 2 Interpret and apply information on the fundamental principles of vessel construction, the theories and factors affecting trim and stability of a vessel and the required measures necessary to preserve trim and stability
- 3 Identify and interpret information on the following:
 - i the effect on vessel's stability of:
 - free surface of a liquid
 - shift of cargo
 - wind heel
 - handling of heavy weights
 - ii the effect of excessive trim and swell conditions on stability
 - iii the effect of radius of gyration on the rolling period of the vessel
 - iv the causes of heel and the repercussions of a heeling vessel
- 4 Interpret and analyse a vessel's dynamic stability
- 5 Determine the effect of a damaged condition on stability and trim
- 6 Work collaboratively with other shipboard personnel when determining and maintaining a vessel's stability and trim
- 7 Carry out calculations involved in
 - i computing the hydrostatic stability data of a vessel using Simpson's Rules
 - ii calculating the position of the vessel's metacentre

- 9 Construction, layout and subdivision requirements of a typical vessel, including an understanding of freeboard and bulkhead deck, watertight compartments, weathertight compartments, the bulkhead of the vessel and collision bulkhead
 - iii calculating transverse and longitudinal stability using hydrostatic data
 - iv determining by calculation the change of draft and trim when entering different water densities
 - v determining by calculation the required weight distribution to achieve a desired trim
 - vi calculating the effect on stability of dry docking and grounding
- 8 Use appropriate computer programs as required to analyse a vessel's stability and trim

Evidence Guide

Evidence Guide

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The Evidence Guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

1 Critical aspects of evidence required to demonstrate competency in this unit	Assessment must confirm appropriate knowledge and skills to: <ul style="list-style-type: none"> a Monitor and maintain the stability and stress conditions of a vessel at all times b Carry out all calculations required to assess and analyse the stability and stress conditions of a vessel c Communicate effectively with others concerning operations to maintain the trim, stability and stress conditions of a vessel
2 Evidence required for demonstration of consistent	<ul style="list-style-type: none"> a Performance is demonstrated consistently over a period of time and in a suitable range of contexts b Consistently applies underpinning knowledge and skills when:

Evidence Guide**TDMMA1007B CONTROL TRIM, STABILITY AND STRESS****performance**

- 1 controlling the trim and stability and managing the stresses of a vessel
 - 2 identifying and evaluating trim, stability and stress problems and determining appropriate courses of action
 - 3 completing all calculations needed to assess and analyse the stability and stress conditions of a vessel
 - 4 identifying and implementing improvements to procedures for the control of trim and stability of a vessel
 - 5 applying safety precautions relevant to manoeuvring operations
 - 6 assessing trim and stability of vessel in both normal and emergency situations
- c Shows evidence of application of relevant workplace procedures, including:
- 1 relevant sections of IMO Conventions and Codes and AMSA Marine Orders
 - 2 ISM Code and associated vessel's safety management system and procedures
 - 3 OH&S regulations and hazard prevention policies and procedures
 - 4 job procedures and work instructions
 - 5 relevant manufacturer's guidelines relating to the trim, stability and stress limits of the vessel
 - 6 quality procedures (where existing)
 - 7 procedures to protect the integrity and security of the vessel's hull
 - 8 environmental protection procedures when pumping ballast water
- d Action is taken promptly to report and/or rectify out-of-limit

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trim, stability and stresses of the vessel in accordance with manufacturer's instructions, statutory requirements and company procedures

Evidence Guide (continued)**TDMMA1007B CONTROL TRIM, STABILITY AND STRESS**

2 Evidence required for demonstration of consistent performance (continued)	<p>e Work is completed systematically with required attention to detail</p> <p>f Recognises and adapts appropriately to cultural differences in the workplace, including modes of behaviour and interactions among crew and others</p>
3 Context of assessment	<p>a Assessment of competency must comply with the assessment requirements of the relevant maritime regulations</p> <p>b Assessment of this unit must be undertaken within relevant marine authority approved and audited arrangements by a registered training organisation:</p> <ol style="list-style-type: none"> 1 As a minimum, assessment of knowledge must be conducted through appropriate written/oral examinations, and 2 Appropriate practical assessment must occur: <ol style="list-style-type: none"> i at the registered training organisation; and/or ii on an appropriate working or training vessel
4 Specific resources required for assessment	<p>Access is required to opportunities to:</p> <p>a participate in a range of exercises, case studies and other simulated practical and knowledge assessments that demonstrate the skills and knowledge to maintain the trim and stability of a vessel in a range of operational situations; and/or</p>

Evidence Guide (continued)**TDMMA1007B CONTROL TRIM, STABILITY AND STRESS**

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| | <p>b the trim and stability of a vessel in a range of operational situations either:</p> <p>i using a simulator, meeting the requirements of Section A I/12 of the IMO STCW Code, over an appropriate range of simulated loading and operational situations</p> <p>ii in appropriate practical situations on an operational commercial or training vessel</p> |
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Range Statement**Range Statement****TDMMA1007B CONTROL TRIM, STABILITY AND STRESS**

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

VARIABLE**SCOPE****1. GENERAL CONTEXT**

a. Work must be carried out:	1	in compliance with mandatory rules and regulations and IMO Conventions and Codes, including the relevant sections of the AMSA Marine Orders and ensuring that applicable codes, guidelines and standards recommended by IMO, the classification societies and maritime industry organisations are taken into account
b. Work is performed:	1	independently under broad operational requirements, with accountability and responsibility for self and others in achieving the prescribed outcomes

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c. Work involves:	1 the application of fundamental principles of vessel construction and theories of trim and stability and stress in the development and implementation of measures to preserve the trim and stability of a vessel across a wide and often unpredictable range of normal and emergency operational contexts. The development of a broad strategy and techniques for controlling vessel trim, stability and stress is required. Accountability and responsibility for self and others in achieving the outcomes is involved
d. Work requires:	1 significant judgement in technical, organisational and leadership functions related to controlling the trim and stability of vessels of 500 gross tonnage or more

2. WORKSITE ENVIRONMENT

a Vessel may include:	1 any Australian or international commercial vessel of 500 gross tonnage or more (in the case of masters), or 3,000 kW propulsion power (in the case of engineers)
b Measures to control the trim and stability of the vessel may be carried out:	1 by day or night in both normal and emergency situations 2 under any possible conditions of weather and loading 3 while loading and unloading 4 while underway

Range Statement (continued)**TDMMA1007B CONTROL TRIM, STABILITY AND STRESS**

VARIABLE	SCOPE
b Measures to control the trim and stability of the vessel may be carried out: (continued)	5 during berthing and unberthing operations 6 while anchoring or mooring 7 when bunkering
c Measures to control the trim and stability of the vessel may include:	1 adjusting weight distribution of load 2 pumping ballast water to compensate for load distribution 3 pumping of flooded compartments 4 implementing damage control measures to maximise watertight integrity of hull where it has been damaged
d Documentation and records may include:	1 ISM Code safety management system plans, procedures, checklists and instructions 2 operational orders 3 IMO Conventions and Codes 4 AMSA Marine Orders 5 IMO SOLAS Convention 6 vessel's log 7 'Trim and Stability Booklet' 8 company procedures 9 vessel manufacturer's instructions and recommended

Range Statement (continued)**TDMMA1007B CONTROL TRIM, STABILITY AND STRESS**

	procedures
	10 instructions of relevant maritime authorities
	11 relevant Australian and international standards
	12 Classification society rules
e Applicable legislation, regulations and codes may include:	1 IMO Conventions and Codes related to vessels of 500 gross tonnage or more 2 relevant sections of AMSA Marine Orders concerning vessel trim and stability 3 IMO SOLAS Convention 4 relevant international, Commonwealth, State and Territory OH&S legislation

Unit Sector(s)

Not applicable.

Field

Field MA Handling Cargo and Vessel Stability

Relationship to other units

Relationship to other units	The unit may be assessed in conjunction with other units that relate to the functions of the occupation(s) concerned.
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