MODEL COURSE 7.01

MASTER AND CHIEF MATE

IMO

International Maritime Organization

Model Course 7.01

Master and Chief Mate

IMO

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Introduction

■ Purpose of the model courses

The purpose of the IMO model courses is to assist maritime training institutes and their teaching staff in organizing and introducing new training courses, or in enhancing, updating or supplementing existing training material where the quality and effectiveness of the training courses may thereby be improved.

It is not the intention of the model course programme to present instructors with a rigid "teaching package" which they are expected to "follow blindly". Nor is it the intention to substitute audio-visual or "programmed" material for the instructor's presence. As in all training endeavours, the knowledge, skills and dedication of the instructors are the key components in the transfer of knowledge and skills to those being trained through IMO model course material.

The educational systems and the cultural backgrounds of trainees in maritime subjects vary considerably from country to country. For this reason the model course material has been designed to identify the basic entry requirements and trainee target group for each course in universally applicable terms, and to specify clearly the technical content and levels of knowledge and skill necessary to meet the technical intent of IMO conventions and related recommendations.

This is the first major revision to this Model Course. In order to keep the training programme up to date in future, it is essential that users provide feedback. New information will provide better training in safety at sea and protection of the marine environment. Information, comments and suggestions should be sent to the Head of the STCW and Human Element Section at IMO, London.

■ Use of the model course

To use the model course the instructor should review the course plan and detailed syllabus, taking into account the information provided under the entry standards specified in the course framework. The actual level of knowledge and skills and the prior technical education of the trainees should be kept in mind during this review, and any areas within the detailed syllabus which may cause difficulties, because of differences between the actual trainee entry level and that assumed by the course designer, should be identified. To compensate for such differences, the instructor is expected to delete from the course, or reduce the emphasis on, items dealing with knowledge or skills already attained by the trainees. He should also identify any academic knowledge, skills or technical training which they may not have acquired.

By analysing the detailed syllabus and the academic knowledge required to allow training in the technical area to proceed, the instructor can design an appropriate pre-entry course or, alternatively, insert the elements of academic knowledge required to support the technical training elements concerned at appropriate points within the technical course.

Adjustment of the course objective, scope and content may also be necessary if in your maritime industry the trainees completing the course are to undertake duties which differ from the course objectives specified in the model course.

Within the course plan the course designers have indicated their assessment of the time which should be allotted to each area of learning. However, it must be appreciated that these allocations are arbitrary and assume that the trainees have fully met all entry requirements of the course. The instructor should therefore review these assessments carefully and may need to re-allocate the time required to achieve each specific learning objective or training outcome.

■ Lesson plans

Having adjusted the course content to suit the trainee intake and any revision of the course objectives, the instructor should draw up lesson plans based on the detailed syllabus. The detailed syllabus contains specific references to the textbooks or teaching material proposed to be used in the course. Where no adjustment is found necessary in the learning objectives of the detailed syllabus, the lesson plans may simply consist of the detailed syllabus with keywords or other reminders added to assist the instructor in making his presentation of the material.

■ Presentation

The presentation of concepts and methodologies must be repeated in various ways until the instructor is satisfied, by testing and evaluating the trainee's performance and achievements, that the trainee has attained each specific learning objective or training outcome. The syllabus is laid out in learning objective format and each objective specifies a *required performance* or, *what the trainee must be able to do* as the learning or training outcome. Taken as a whole, these objectives aim to meet the knowledge, understanding and proficiency specified in the appropriate tables of the STCW Code.

■ Implementation

For the course to run smoothly and to be effective, considerable attention must be paid to the availability and use of:

- Properly qualified instructors
- Support staff
- Rooms and other spaces
- Equipment
- Suggested references, textbooks, technical papers
- Other reference material.

Thorough preparation is the key to successful implementation of the course. IMO has produced a booklet entitled "Guidance on the implementation of IMO model courses", which deals with this aspect in greater detail.

In certain cases, the requirements for some or all of the training in a subject are covered by another IMO model course. In these cases, the specific part of the STCW Code which applies is given and the user is referred to the other model course.

■ Course objective

This model course comprises three functions at the management level. On successful completion of the course and the requisite watchkeeping experience, officers will be capable of taking full responsibility for the safety of the ship, its passengers, crew and cargo. They will be aware of their obligations under international agreements and conventions concerning safety and the protection of the marine environment and will be able to take the practical measures necessary to meet those obligations.

In this model course, one combined course has been written for both chief mate and master. The material is set out so that it can be run separately from the course for officer in charge of a navigational watch, but this is not intended to imply that it has to be run separately. It has been written in this manner so as to give Administrations the opportunity to arrange a structure best suited to their needs.

The teaching schemes should be carefully scrutinized to ensure that all of the tabulated training outcomes are covered, that repetition is avoided and that essential underpinning knowledge at any stage has already been covered. A certain amount of duplication under different subjects will probably occur. Providing it is not excessive, the different approaches can provide useful reinforcement of work already learned. Care should be taken to see that items not included in the syllabus or treatment beyond the depth indicated by the objectives have not been introduced except where necessary to meet additional requirements of the Administration. The teaching scheme should be adjusted to take account of those matters and the timing of any modular courses (such as training in Fire Fighting, Medical Care) which are to be included.

■ Entry standards

Entrants should have successfully completed a course covering the minimum standards required for certification as officer in charge of a navigational watch on ships of 500 gross tonnage or more (see IMO Model Course No. 7.03, Officer in Charge of a Navigational Watch).

■ Class intake limitations

Class sizes should be limited to not more than 24 in order to allow the instructor to give adequate attention to individual trainees. Larger numbers may be admitted if extra staff and tutorial periods are provided to deal with trainees on an individual basis. In addition, for scheduling access to learning facilities and equipment, attention to strict time management is necessary. In large classes students should have their own reference books, unless sufficient copies can be provided in a central library. Classrooms should be big enough to seat all students so they can see and hear the instructor.

During practical sessions and group activities there will be additional restraints on class size. Where applicable, a recommendation on class size is contained in the frameworks for each of the individual functions.

■ Textbooks

References to books are made in the syllabuses of the individual subjects to aid both instructors and trainees in finding relevant information and to help in defining the scope and depth of treatment intended.

The mention of a particular textbook does not imply that it is essential to use that book, only that it appeared to be best suited to the course at the time of its design. In many instances there are a number of suitable books, and instructors are free to use whatever texts they consider to be most suited to their circumstances and trainees.

Every effort has been made to quote the latest editions of the publications mentioned but new editions are constantly being produced. Instructors should always use the latest edition for preparing and running their courses.

Full use should be made of technical papers and other publications available from maritime and other professional organizations. Such papers contain new developments in techniques, equipment, design, management and opinion and are an invaluable as set to a maritime training establishment.

■ English language

The requirements for knowledge of the English language are the same at the management level as they are at the operational level. However, Administrations may consider that a knowledge of English at a higher level would be desirable for a master and chief mate and may wish to include a further course in English for conducting ship's business, as outlined below:

- reads and understands charter parties, bills of lading, mate's receipts, marine insurance clauses, port and canal regulations
- interprets appropriate endorsements on mate's receipts and bills of lading
- completes a note of protest in English
- writes reports on damage to ship or cargo, on and off-hire surveys accidents and incidents
- writes letters to agents, port authorities and stevedores concerning ship's business and reads replies from them
- writes requests for surveys and interprets requests and instructions from surveyors
- requests fuel, water, ship's stores and spares, verbally and in writing
- reads and understands manufacturers' instructions for operation and maintenance of equipment.

■ IT and computer applications

In view of the rapid growth of information technology (IT) and widespread use of computers aboard ship, it is recommended that at the discretion of the Administration, computer applications at an advanced level should be included in the training for master and chief mate. If this topic has not been covered during training as officer in charge of a navigational watch some basic training will also be required.

Particulars of the training will depend upon the computer facilities available and the needs of the trainees. The following outline provides guidance on topics which could be included.

- The care and storage of magnetic media; use of simple utility programs for identifying disk problems and fixes; LAN maintenance; back-up management; virus protection.
- IT and the use of applications, for communications (e-mail, data, etc), the internet, intranets and the world-wide web (WWW).

- The installation and setup of multi-media applications.

In addition applications of computers and micro-processors to instrumentation and control systems, including:

- simple digital circuits, binary logic switches, bistable circuits
- logic gates, truth tables of simple logic circuits
- representation of data by bits, bytes and words, binary and hexadecimal representation
- binary-coded decimal representation, fixed- and floating-point numbers, ASCII Code
- analogue-to-digital and digital-to-analogue converters
- computer architecture, information transfer between principal units
- memory, ROM, RAM, direct access memory, virtual memory
- input and output devices, data transfer, modems, multiplexers
- block diagrams of computer supervisory control systems and direct digital control systems
- automatic monitoring, data-recording and alarm systems.

The use of multi-media applications can enhance learning in topics in many areas of knowledge and prove of value to junior officers and crew members. Many of the IMO rules and Assembly Resolutions are available on CD-ROM. Up to date details may be found on the IMO web site at http://www.imo.org

■ Shipping economics

It is recommended that, at the discretion of the Administration, the subject of shipping economics should be included in the course of studies for master and chief mate. The objective is to make trainees aware of economic considerations in ship management and how sound operational practices can contribute to the economic success of a voyage.

The following general objectives provide guidance on topics which could be included . Matters of national or regional interest regarding local trade and the operation of shipping should be incorporated where appropriate:

outlines the main world seaborne trade routes in various commodities

describes the main features of the following trades:
- tramp or general traders
- liner
- specialized (tanker, container, timber products, etc.)
- passenger (cruising, ferries)

describes the structure and organization of:
- a typical shipping company
- a ship management company

schedules economic purchasing of stores, bunkers etc based on the ship's area of operation

establishes the safe and economic manning of a ship based on valid arguments and proper usage of repair and maintenance assistance

plans the operation of the ship for a 12 month period

prepares an annual operating cost budget

describes the division of a shipping company between capital and labour

describes the operation of the freight market with reference to the price elasticity of supply and demand

explains how freight rates vary:
- under free competition
- under monopolistic competition
- conferences, cartels, pooling arrangements, etc.

describes fluctuations in the freight markets

explains the significance of the following with regard to operating policy:
- capital costs
- fixed costs
- variable costs
- marginal costs
- interest rate
- depreciation or amortization
- risk element
- return on capital

lists and describes the following voyage costs:
- crew
- fuel
- repairs and maintenance
- insurance
- port dues
- cargo handling

identifies cost elements on which the shipboard management team can influence the results

explains how voyage costs are influenced by the operation of a ship and describes measures which can be taken to minimise those costs

describes how costs are apportioned under the various types of charter party.

■ Training and the STCW 1995 Convention

The standards of competence that have to be met by seafarers are defined in Part A of the STCW Code in the Standards of Training, Certification and Watchkeeping for Seafarers Convention, as amended in 1995. This IMO model course has been revised and updated to cover the competences in STCW 1995. It sets out the education and training to achieve those standards.

In common with the Convention, the course is organised under the seven functions at three levels of responsibility. Specifically, this course covers the minimum standard of competence for masters and chief mates on ships of 500 gross tonnage or more, see STCW Code Table A-II/2.

For ease of reference, the course material is organised in three separate Functions as per the STCW Code. These functions are:

Function 1	Navigation at the management level
Function 2	Cargo handling and stowage at the management level
Function 3	Controlling the operation of the ship and care for the persons on board at the management level.

Each function is addressed in three parts: Part A, Part B and Part C.

Part A provides the framework for the course with its aims and objectives and notes on the suggested teaching facilities and equipment. A list of useful teaching aids, IMO references and textbooks is also included.

Part B provides an outline of lectures, demonstrations and exercises for the course. No detailed timetable is suggested. From the teaching and learning point of view, it is more important that the trainee achieves the minimum standard of competence defined in the STCW Code than that a strict timetable is followed. Depending on their experience and ability, some students will naturally take longer to become proficient in some topics than in others. Also included in this section are guidance notes and additional explanations.

A separate IMO model course addresses Assessment of Competence. This course explains the use of various methods for demonstrating competence and criteria for evaluating competence as tabulated in the STCW Code.

Part C gives the Detailed Teaching Syllabus. This is based on the theoretical and practical knowledge specified in the STCW Code. It is written as a series of learning objectives, in other words what the trainee is expected to be able to do as a result of the teaching and training. Each of the objectives is expanded to define a required performance of knowledge, understanding and proficiency. IMO references, textbook references and suggested teaching aids are included to assist the teacher in designing lessons.

There are new competence requirements in STCW 1995 concerning masters and chief mates, that did not appear in the 1978 Convention. These new requirements include:

- ship routeing and reporting
- bridge teamwork
- blind pilotage and inter-relationship and use of all available navigational data
- use of publications

- emergency towing
- rate of turn, current, ship and tug interactions, use of manoeuvring systems
- manoeuvres for rescue boats
- VTS
- automatic data-based equipment
- BC Code
- national legislation
- preparation of contingency plans.

These new training requirements are addressed in the appropriate parts of the detailed teaching syllabus.

The Convention defines the minimum standards to be maintained in Part A of the STCW Code. Mandatory provisions concerning Training and Assessment are given in Section A-I/6 of the STCW Code. These provisions cover: qualification of instructors; supervisors as assessors; in-service training; assessment of competence; and training and assessment within an institution. The corresponding Part B of the STCW Code contains guidance on training and assessment.

The criteria for evaluating competence specified in the minimum standard of competence tables of Part A of the STCW Code are to be used in the assessment of all competences listed in those tables.

As previously mentioned a separate model course addresses Assessment of Competence and use of the criteria for evaluating competence tabulated in the STCW Code.

■ Responsibilities of Administrations

Administrations should ensure that training courses delivered by colleges and academies are such as to ensure officers completing training do meet the standards of competence required by STCW Regulation II/1 paragraph 2.

■ Validation

The information contained in this document has been validated by the Sub-Committee on Standards of Training and Watchkeeping for use by technical advisers, consultants and experts for the training and certification of seafarers so that the minimum standards implemented may be as uniform as possible. *Validation* in the context of this document means that no grounds have been found to object to its content. The Sub-Committee has not granted its approval to the document, as it considers that this work must not be regarded as an official interpretation of the Convention.

Master and Chief Mate

Function 1:

Navigation at the Management Level

Master and Chief Mate
Function 1: Navigation at the Management Level

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- 1.6 Maintain safe navigation through the use of radar and ARPA and modern navigational systems to assist in command decision-making
- 1.7 Forecast weather and oceanographic conditions
- 1.8 Respond to navigational emergencies
- 1.9 Manoeuvre and handle a ship in all conditions
- 1.10 Operate remote controls of propulsion plant and engineering systems and services

Function 1 – Navigation at the Management Level

Part A1: Course Framework

Aims

This model course aims to meet the mandatory minimum requirements for knowledge, understanding and proficiency in Table A-II/2 of STCW 1995 for the function Navigation at the Management Level.

Objective

This syllabus covers the requirements of the 1995 STCW Convention Chapter II, Section A-II/2. This functional element provides the detailed knowledge to support the training outcomes related to the Navigation at the Management Level.

This section provides the background knowledge to support the tasks, duties and responsibilities in:

- planning a voyage and conducting navigation
- determining position and the accuracy of resultant position fix by any means
- determining and allowing for compass errors
- co-ordinating search and rescue operations
- establishing watchkeeping arrangements and procedures
- maintaining safe navigation through the use of radar and ARPA and modern navigation systems to assist command decision-making
- forecasting weather and oceanographic conditions
- response to navigational emergencies
- manoeuvring and handling a ship in all conditions
- operation of remote controls of propulsion plant and engineering systems and services.

Entry standards

This course is principally intended for officers for certification as master and chief mate on ships of 500 gross tonnage or more (see IMO Model Course No. 7.03, Officer in Charge of a Navigational Watch).

Course certificate

On successful completion of the course and assessments, a document may be issued certifying that the holder has successfully completed a course of training which meets or exceeds the level of knowledge and competence specified in Table A-II/2 of STCW 1995, for the function Navigation at the Management Level.

A certificate may be issued only by centres approved by the Administration.

Staff requirements

Instructors shall be qualified in the task for which training is being conducted and have appropriate training in instructional techniques and training methods (STCW Code Section A-I/6). Depending on the complexity of the exercises set, an assistant instructor with similar experience is desirable for certain practical exercises.

Teaching facilities and equipment

A classroom equipped with an overhead projector and a blackboard or flipchart should be provided for teaching the theory of the course and holding group discussions.

The following items are necessary for use in group work:

COLREGS '72 – a set of table-top models displaying proper signals or lights, a magnetic board or a navigation light simulator

Manoeuvring – a set of models to represent ships, jetties, piers and other dock configurations, which can be used on a table top to illustrate ship handling techniques

Teaching aids (A)

A1 Instructor Guidance (Part B of this course)
A2 Catalogue of British Admiralty charts and other hydrographic publications
A3 British Admiralty Notices to Mariners
A4 Nautical Almanac
A5 Nautical tables (Norie's, Burton's or others)
A6 Pre-computed altitude and azimuth tables (e.g. HO229)
A7 Pocket calculator
A8 Working chart
A9 Ocean plotting sheet
A10 Passage planning charts
A11 Routeing charts
A12 Ocean Passages for the World (NP 136), (Taunton, Hydrographer of the Navy, 1987)
A13 Distance tables
A14 British Admiralty list of lights
A15 National list of lights and buoyage system
A16 British Admiralty tide table of the area concerned
A17 Local tide table
A18 Tidal stream atlas
A19 British Admiralty 'Pilot' book for the area concerned
A20 National sailing directions
A21 Port information books
A22 IALA Maritime Buoyage System, Admiralty NP 735
A23 British Admiralty List of Radio Signals, Vol. 2: Radio Navigational Aids
A24 British Admiralty List of Radio Signals, Vol. 5: Radio Time Signals, Radio Navigational Warnings
A25 British Admiralty List of Radio Signals, Vol. 6: Pilot Services and Port Operations. Parts 1 and 2
A26 British Admiralty List of Radio Signals, Vol. 7: Vessel Traffic Services and Reporting Systems. Parts 1 and 2
A27 Ship's log-book
A28 Loran-C Receiver
A29 Magnetic compass in a binnacle with necessary correcting devices
A30 Pelorus and azimuth mirror
A31 Gyro-compass
A32 Satellite Navigation Receivers

Video cassettes

V1 Preparing the defence (IMO Code No. VID-301)

Available from: IMO Publications Section
4 Albert Embankment
London SE1 7SR, UK
Fax: 44 171 587 3241
URL: www.imo.org

V2 Master/pilot relationship (Code No 498)
V3 Search and rescue: co-ordination (Code No 574)
V4 Shiphandling – Part 1 (Code No 95)
V5 Shiphandling – Part 2 (Code No 129)
V6 Shiphandling – Part 3 (Code No 321)
V7 Interaction (Code No 13)
V8 Ship handling in following seas (Code No 636)

Available from: Videotel Marine International Ltd
84 Newman Street, London W1P 3LD, UK
Tel : 44 171 299 1800
Fax: 44 171 299 1818
e-mail: mail@videotelmail.com
URL: www.videotel.co.uk

IMO references (R)

R1 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1995 (IMO Sales No. 938), and 1997 Amendments to STCW 95 (IMO Sales No. 945)
R2 International Convention for the Safety of Life at Sea (SOLAS), as amended (IMO Sales No. 110)
R3 Ships' Routeing (1991, 6th ed.) (IMO Sales No. 927);1992 Amendments to Ships' Routeing (IMO Sales No. 924) and 1996 Amendments (IMO Sales No. 921)
R4 Assembly resolution A.223 (VII): Performance standards for radio direction-finding systems
R5 Assembly resolution A.574 (14): Recommendation on general requirements for electronic navigational aids
R6 Assembly resolution A.382 (X): Magnetic compasses: carriage and performance standards
R7 Assembly resolution A.424 (XI): Performance standards for gyro-compasses
R8 Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS 1972), as amended (IMO Sales No. 904)
R9 International Convention for the prevention of Pollution from Ships, 1973 (MARPOL 1973) (in IMO sales No. 520)
R10 Regulations for the Prevention of Pollution by Oil – Annex 1, MARPOL 73/78 (in IMO Sales No. 520)
R11 Regulations for the Control of Pollution by Noxious Substances in Bulk – Annex II, MARPOL 73/78 (in IMO Sales No. 520)
R12 Guidelines for the implementation of Annex V of MARPOL 73/78 (in IMO Sales No. 520)
R13 Manual on Oil Pollution, Section 1 – Prevention (IMO Sales No. 557)

R14 Assembly resolution A.648 (16) – General Principles for Ship Reporting Systems and Ship Reporting Requirements, including Guidelines for Reporting Incidents Involving Dangerous Goods, Harmful Substances and/or Marine Pollutants
R15 Assembly resolution A.626 (15) – Amendments to the International Regulations for Preventing Collisions at Sea, 1972
R16 Assembly resolution A.678 (16) – Amendment to the International Regulations for Preventing Collisions at Sea, 1972
R17 Assembly resolution A.601 (15) – Provision and display of manoeuvring information on board ships
R18 Assembly resolution A.160 (ES.IV) – Recommendation on data concerning manoeuvring capabilities and stopping distances of ships
R19 Assembly resolution A.269 (VIII) – Recommendation for skippers of fishing vessels on ensuring a vessel's endurance in conditions of ice formation
R20 Assembly resolution A.275 (VIII) – Recommendation on performance standards for mechanical pilot hoists
R21 Assembly resolution A.426 (XI) – Arrangements for embarking and disembarking pilots in very large ships
R22 Assembly resolution A.528 (13) – Recommendation on weather routeing
R23 Assembly resolution A.667 (16) – Pilot transfer arrangements
R24 Assembly resolution A.439 (XI) – IMCO Search and Rescue Manual
R25 Assembly resolution A.530 (13) – Use of radar transponders for search and rescue purposes
R26 MEPC.14(20) Amendments to Annex I of MARPOL 73/78
R27 MEPC.16(22) Amendments to Annex II of MARPOL 73/78
R28 MEPC.21(22) Amendments to Protocol I to MARPOL 73/78 and the text of the Protocol, as amended, annexed thereto
R29 IMO/ILO Document for Guidance, 1985 (IMO Sales No. 935)
R30 Mersar Manual, 1993 (IMO-963)
R31 IAMSAR Manual, 1998 (IMO Sales No. 960, 962)

Details of distributors of IMO publications that maintain a permanent stock of all IMO publications may be found on the IMO web site at http://www.imo.org

Textbooks (T)

T1 Admiralty Manual of Navigation. Vol 1. London, HMSO 1997 1st impression (ISBN 0-11400-3-68-8)
T3 Bole, A.G. and Dineley, W.O. and Nicholls, C.E. The Navigation control Manual. 2nd ed. Oxford. Heinemann Professional, 1992 (ISBN 0-7506-0542-1)
T10 Danton, G. The Theory and Practice of Seamanship. 11th ed. London, Routledge, 1996 (ISBN 0-4151-5372-7)
T13 Frost, A. Practical Navigation for Second Mates. 6th ed. Glasgow, Brown, Son & Ferguson, 1985 (ISBN 0-8517-4397-8)
T14 Frost, A. The Principles and Practice of Navigation. 3rd ed. Glasgow, Brown, Son & Ferguson, 1988 (ISBN 0-8517-4542-3)
T16 Gylden, S. The Use of Constant Rate Turns OUT OF PRINT 1998
T17 Hensen, H. Tug Use In Port, Nautical Institute (ISBN 1-8700-7739-3)
T21 Hooyer, H.H. The Behaviour and Handling of Ships. Cornell Maritime Press (ISBN 0-7870-33306-2)
T24 International Chamber of Shipping, Bridge Procedures Guide, 3rd ed. 1998

T34 Kemp, J.F.and Young, P. Notes on Compass Work. 2nd ed. London, Stanford Maritime, 1972; reprinted 1987 (ISBN 0-5400-0362-X)

T38 MacElvrey, D.H. Shiphandling for the Mariner. 3rd ed. Centreville (Maryland, US), Cornell Maritime Press, 1995. (ISBN 0-8703-3464-6)

T42 Maritime Meteorology, 2nd. Ed. 1997. Thomas Reed Publications (ISBN 0- 9012-8167-0)

T46 Merrifield, F.G. Ship Magnetism and The Magnetic Compass, Pergamon Press

T47 Meteorological Office, Marine Observer's Handbook. 11th ed. (Met.0.887). London, HMSO, 1995 (ISBN 0-1140-0367-X)

T48 Meteorological Office, Meteorology for Mariners, 3rd ed. 8th impression. London, HMSO, 1978 (ISBN 0-1140-0311-4)

T53 Rowe, R.W. The Shiphandler's Guide. The Nautical Institute. 1996. (ISBN 1-870077 35 0)

T57 Swift, Capt. A.J. Bridge Team Management. – A Practical Guide. The Nautical Institute, 1993. (ISBN 1-8700-7714-8)

T59 Tetley, L. and Calcutt, D. Electronic Aids to Navigation : Position Fixing. 2nd ed. 1986 London, Edward Arnold, 1991 (ISBN 0-3405-4380-9)

T61 The Mariner's Handbook. (NP 100). 6th ed. Taunton (UK), Hydrographer of the Navy, 1989

T66 Taylor, D.A. Introduction to Marine Engineering. 2nd ed. London, Butterworth. 1990. (ISBN 0-4080-5706-8)

Secondhand copies of out of print books may be available from the Warsash Nautical Bookshop, 6 Dibles Road, Warsash, Southampton SO31 9HZ, UK. Tel: 44 1489 572 384 Fax: 44 1489 885756 E-mail: orders@nauticalbooks.co.uk URL: www.nauticalbooks.co.uk

Function 1: Navigation at the Management Level

Part B1: Course Outline

Timetable

No formal example of a timetable is included in this model course.

Development of a detailed timetable depends on the level of skills of the officers entering the course and the amount of revision work of basic principles that may be required.

Lecturers must develop their own timetable depending on:

- the level of skills of trainees
- the numbers to be trained
- the number of instructors

and normal practices at the training establishment.

Preparation and planning constitute an important factor which makes a major contribution to the effective presentation of any course of instruction.

Lectures

As far as possible, lectures should be presented within a familiar context and should make use of practical examples. They should be well illustrated with diagrams, photographs and charts where appropriate, and be related to matter learned during seagoing time.

An effective manner of presentation is to develop a technique of giving information and then reinforcing it. For example, first tell the trainees briefly what you are going to present to them; then cover the topic in detail; and, finally, summarize what you have told them. The use of an overhead projector and the distribution of copies of the transparencies as trainees handouts contribute to the learning process.

Course Outline

The tables that follow list the 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.

COURSE OUTLINE

Knowledge, understanding and proficiency	Total hours for each topic	Total hours for each subject area of Required performance
Competence:		
1.1 PLAN A VOYAGE AND CONDUCT NAVIGATION		
1.1.1 VOYAGE PLANNING AND NAVIGATION FOR ALL CONDITIONS		
.1 Log books	3	
.2 Navigation for all conditions	20	23
1.1.2 ROUTEING IN ACCORDANCE WITH THE GENERAL PRINCIPLES ON SHIP'S ROUTEING		
.1 Routeing	15	15
1.1.3 REPORTING IN ACCORDANCE WITH THE GUIDELINES AND CRITERIA FOR SHIP REPORTING SYSTEMS		
.1 Ship reporting systems	1	1
1.2 DETERMINE POSITION AND THE ACCURACY OF RESULTANT POSITION FIX BY ANY MEANS		
1.2.1 POSITION DETERMINATION IN ALL CONDITIONS		
.1 Terrestrial navigation	24	
.2 Great-circle sailing	10	
.3 Celestial navigation	24	
.4 Tides	10	
.5 Loran-C System	6	
.6 Satellite navigation system	6	80
1.3 DETERMINE AND ALLOW FOR COMPASS ERRORS		
1.3.1 THE PRINCIPLES AND ERRORS OF MAGNETIC COMPASSES		
.1 The principle and errors of magnetic compasses	25	
.2 Gyro-compass errors and corrections	10	35
1.3.2 THE PRINCIPLE AND ERRORS OF GYRO COMPASSES		
.1 The principle and errors of gyro compasses	10	10
1.3.3 SYSTEMS UNDER THE CONTROL OF THE MASTER GYRO AND THE OPERATION OF THE MAIN TYPES OF GYRO-COMPASSES IN USE AT SEA		
.1 Systems under the control of master gyro and the operation of the main types of gyro-compass in use at sea	2	2
1.4 CO-ORDINATE SEARCH AND RESCUE OPERATIONS		
See IMO Model Course No. 1.08 and STCW Reg. I/12		–

Teaching staff should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff available for teaching.

Knowledge, understanding and proficiency		Total hours for each topic	Total hours for each subject area of Required performance
1.5	**ESTABLISH WATCHKEEPING ARRANGEMENTS AND PROCEDURES**		
1.5.1	THE INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA		
.1	COLREGS 1972 and Amendments	30	30
1.5.2	PRINCIPLES TO BE OBSERVED IN KEEPING A NAVIGATIONAL WATCH		
.1	Navigational watch	2	2
1.5.3	EFFECTIVE BRIDGE TEAMWORK PROCEDURES		
.1	Bridge teamwork procedures	3	
.2	Bridge team management	3	
.3	Teamwork	2	8
1.6	**MAINTAIN SAFE NAVIGATION THROUGH THE USE OF RADAR AND ARPA AND MODERN NAVIGATION SYSTEMS TO ASSIST COMMAND DECISION- MAKING**		
	See IMO Model Course No. 1.08 and STCW Reg. I/12		–
1.7	**FORECAST WEATHER AND OCEANOGRAPHIC CONDITIONS**		
1.7.1	SYNOPTIC CHARTS AND WEATHER FORECASTING		
.1	The planetary system of wind and pressure	2	
.2	The weather associated with the principal air mass types	2	
.3	Synoptic and prognostic charts and forecasts from any source	2	
.4	The maritime forecast code and the range of information available through fax transmissions	2	
.5	The main types of floating ice, their origins and movements	2	
.6	The guiding principles relating to the safety of navigation in the vicinity of ice	1	
.7	Conditions leading to ice accretion on ship's superstructures, dangers and remedies available	2	13
1.7.2	CHARACTERISTICS OF VARIOUS WEATHER SYSTEMS		
.1	The formation, structure and weather associated with the principal frontal systems	2	
.2	The formation of, and weather associated with, frontal and non-frontal depressions	2	
.3	The formation and weather characteristics of non-frontal weather systems	2	
.4	Tropical revolving storms (TRS)	2	8
1.7.3	OCEAN CURRENT SYSTEMS		
.1	Surface water circulation of the ocean and principal adjoining seas	2	
.2	The principle of voyage planning with respect to weather conditions and wave height	2	
.3	The formation of sea waves and swell waves	2	6

Teaching staff should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff available for teaching.

Knowledge, understanding and proficiency		Total hours for each topic	Total hours for each subject area of Required performance
1.7.4	CALCULATION OF TIDAL CONDITIONS		
	.1 Apply the relevant weather conditions to tidal calculations	1	1
1.7.5	APPROPRIATE NAVIGATIONAL PUBLICATIONS ON TIDES AND CURRENTS		
	.1 Navigational publications on tides and currents	2	2
1.8.1	PRECAUTIONS WHEN BEACHING A SHIP		
	.1 Precautions when beaching a ship	2	2
1.8.2	ACTION TO BE TAKEN IF GROUNDING IS IMMINENT AND AFTER GROUNDING		
	.1 Action to be taken if grounding is imminent and after grounding	2	2
1.8.3	REFLOATING A GROUNDED SHIP WITH AND WITHOUT ASSISTANCE		
	.1 Refloating	1	1
1.8.4	ACTION TO BE TAKEN IF COLLISION IS IMMINENT AND FOLLOWING A COLLISION OR IMPAIRMENT OF THE WATERTIGHT INTEGRITY OF THE HULL BY ANY MEANS		
	.1 Collision	2	2
1.8.5	ASSESSMENT OF DAMAGE CONTROL		
	.1 Assessment of damage control	1	1
1.8.6	EMERGENCY STEERING		
	.1 Emergency steering	2	2
1.8.7	EMERGENCY TOWING ARRANGEMENTS AND TOWING PROCEDURES		
	.1 Emergency towing arrangements	2	2

1.9 MANOEUVRE AND HANDLE A SHIP IN ALL CONDITIONS

1.9.1	MANOEUVRING AND HANDLING A SHIP IN ALL CONDITIONS		
	.1 Approaching a pilot vessel	4	
	.2 Ship handling in restricted waters	10	
	.3 Constant rate of turn techniques	1	
	.4 Manoeuvring in shallow water	2	
	.5 Interaction: bank, canal, ship and tug	2	
	.6 Berthing and unberthing	12	
	.7 Use of propulsion and manoeuvring systems	1	
	.8 Anchoring	6	
	.9 Drydocking	2	
	.10 Handling ships in heavy weather	6	
	.11 Rescue boats and survival craft	2	
	.12 Manoeuvring and propulsion characteristics	3	
	.13 Damage due to own ship's bow and stern waves	1	
	.14 Navigating in or near ice	3	
	.15 Manoeuvring in traffic separation schemes and VTS	2	57

Teaching staff should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff available for teaching.

Knowledge, understanding and proficiency	Total hours for each topic	Total hours for each subject area of Required performance

1.10 OPERATE REMOTE CONTROLS OF PROPULSION PLANT AND ENGINEERING SYSTEMS AND SERVICES

1.10.1 OPERATING PRINCIPLES OF MARINE POWER PLANTS	34	34
1.10.2 SHIPS' AUXILIARY MACHINERY	36	36
1.10.3 GENERAL KNOWLEDGE OF MARINE ENGINEERING TERMS		
.1 Marine engineering terms and fuel consumption	4	4

Total for Function 1: Navigation at the Management Level 379

Teaching staff should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff available for teaching.

Guidance Notes

The following notes are intended to highlight the main objectives or training outcomes of each part of the function. The notes also contain some material on topics which are not adequately covered in the quoted references.

This function covers the theoretical knowledge, understanding and proficiency for the safe navigation of a ship in coastal waters and in the open ocean.

Function 1: Navigation at the Management Level

On completion of training for this function, the officer will possess a thorough understanding and capability in navigation. This together with knowledge gained in other areas, will enable the officer to carry out passages independently in a proper and safe manner and to be able to solve those problems that may arise during a voyage.

The officer will be able to fix positions and analyse in a practical way the quality of the fix, make great circle calculations, read tide tables and predict times and heights of tides at different ports worldwide.

In voyage planning the officer will be able to:

- use appropriate means of navigation in coastal waters
- make use of publications and other information sources for safe voyage planning in coastal waters
- use pilot charts, *Ocean Passages for the World* and other publications to select a safe and economic 'best' route
- organize and manage the bridge team.

Officers will be thoroughly conversant with the International Regulations for Preventing Collisions at Sea (COLREG 1972) and interpretations of them arising from court decisions. They will be able to apply them correctly in all situations as master of a ship.

Officers will be able to arrange and monitor the keeping of a safe navigational watch at sea and an effective deck watch in port taking account of the standards regarding watchkeeping in the STCW Code Chapter VIII. They will have a knowledge of all modern navigational aids, enabling them to navigate safely in all parts of the world. They will have specific knowledge of operating principles, limitations, sources of error, detection of misrepresentation of information and methods of correction to obtain accurate position fixing. Officers will appreciate the danger of exclusive reliance on information gained from instruments and the necessity for calibration and frequent checking of the instruments.

On completion of the function officers will have a thorough knowledge of the theory of magnetism as applied to the earth's field and magnetic conditions aboard ship. They will understand the reasons for the change of compass deviation with time and position and the need for routine checking of the ship's deviation. They will also be able to produce and analyse a deviation table, make a tentative adjustment of the ship's compass and understand the further adjustments to make in the light of deviations experienced. Officers will have a knowledge and understanding of gyro-compass errors and will be able to evaluate possible errors and appreciate the limitations of the instrument.

On completion of the function, officers will :

- possess a general understanding of the elements and processes which determine the weather:
- be able to draw conclusions on the basis of observations made on board and from information available;
- be able to utilize information from weather and wave charts; and
- have a basic knowledge of the elements of oceanography.

This knowledge will, as part of the training programme as a whole, enable the trainee to take into account climatic conditions, the weather prognosis, ocean currents and information on the presence of ice for the safe operation of the ship.

The officer will understand and interpret a synoptic chart, predict area weather, have a knowledge of the characteristics of various weather systems and ocean current systems and be able to use all appropriate navigational publications.

Officers will also be aware of all of the factors affecting the manoeuvring and handling of ships. They will be able to plan berthing or anchoring procedures, taking account of prevailing conditions of wind and tide and their own ship's characteristics, and to make use of assisting tugs when necessary. They will, after having gained seagoing experience or training on a ship-handling simulator, also be able to handle a ship so as to minimize the risk of damage or stranding resulting from heavy weather. Officers will be aware of the dangers to be encountered when navigating in ice or conditions of ice accumulation on board and the precautions to take for the safety of the ship and crew.

Officers will know the procedures to use in VHF communications and be able to use radiotelephones, particularly with respect to distress, urgency, safety and navigational messages. They will also know the procedures for emergency distress signals by radiotelegraphy, as prescribed in the Radio Regulations, and will be able to send a distress call by using an automatic keying device and the emergency transmitter.

The radiocommunications requirements of the 1974 SOLAS Convention, as amended, and the procedures for distress, urgency, safety and navigational messages in accordance with chapter NIX of the Radio Regulations will be known.

1.1 Plan a Voyage and Conduct Navigation

First of all, the officers should be well acquainted with publications which supply appropriate information for voyage planning. Intelligent use of the information, together with professional ability and watchfulness, leads to a successful voyage. Proper safe working procedures are very important and should be stressed. Instructors will find T24 a valuable source of reference.

1.1.1 VOYAGE PLANNING AND NAVIGATION FOR ALL CONDITIONS

Log books

On board ship, various conditions need to be watched and taken care of. In a nautical context this means navigation, including watchkeeping, weather, shiphandling, handling of cargo, condition of ship as to stability, trim, stress, etc., personnel management and communications, which are the most important subjects. Proper and effective keeping of log-books is important, as a record of the various circumstances. Special emphasis should be placed on conditions involving maritime shipping legislation and other regulations and on keeping log-books in normal circumstances.

The importance of preparing oneself and the vessel before setting off on a sea passage is irrefutable, especially on a coastal passage where the sheer number and proximity of hazards can quickly spell disaster for the unprepared.

Navigation Safety recommends that:

1) all of the ship's navigation is planned in adequate detail:
2) there is a systematic bridge organization that provides for:

   (a) comprehensive briefing of personnel
   (b) close monitoring of position
   (c) cross-checking.

1.1.2 ROUTEING IN ACCORDANCE WITH THE GENERAL PRINCIPLES OF SHIP'S ROUTEING

Weather routeing

The procedures for weather routeing by a shore-based service should be covered in this topic. On-board routeing can be carried out by the master if the ship is equipped with a facsimile receiver and is in a region for which the necessary prognostic charts are available.

This topic should be taught in conjunction with the voyage-planning.

Ocean voyage

Because traffic concentrations are low and navigational hazards are relatively few on an ocean crossing, the main data to be appraised are environmental, such as seasonal prevailing weather, local and actual weather, ocean currents, tides, ice, etc. In addition, data of the ship's characteristics, cargo and navigational/operational data need to be taken into account. The main reason for selection of alternative routes is one of safety and economics. Route selection is to some extent regulated by insurance restrictions, load-line zones, IMO routeings and similar regulations.

A thorough analysis of all of the conditions relevant to passage planning should be covered in this subject area. Such an analysis may start with calculating distances of possible tracks and then evaluating weather conditions, current, characteristics of the ship and of its cargo, regulations, etc. Very often the "best" route is not the shortest.

1.1.3 REPORTING IN ACCORDANCE WITH THE GUIDELINES AND CRITERIA FOR SHIP REPORTING SYSTEMS

Ship reporting systems

Instructors should note that ref R3 contains full information on ship's routeing and reporting. A new part G to this publication includes descriptions of ship reporting systems and mandatory routeing measures.

A new voluntary ship movement reporting scheme (MAREP) has been established in the English Channel and it is recommended that all merchant ships of 300 gross tonnage and over participate in the scheme.

1.2 Determine Position And The Accuracy of Resultant Position Fix by Any Means

1.2.1 POSITION DETERMINATION IN ALL CONDITIONS

Terrestrial Navigation

This subject area is intended to give the trainee sufficient knowledge and ability in:

1) chart projections, with the emphasis on those appropriate to navigational use;
2) sailing calculations, using the Mercator formula;
3) simple analysis of errors that may occur in position fixing.

The latter is a very important task. As far as mathematical knowledge permits, statistical methods may be used. A more practical approach to the problem may in most cases be more fruitful. The trainees' ability to make critical judgements and to adopt a critical attitude should be encouraged. In particular, the understanding of possible errors, limitations of accuracy and the need for repeated observations must be stressed.

Calculation of the course, distance and intermediate positions should be practised by working a sufficient number of exercises. The choice of formulae and the method of calculation are optional. In the case of a pocket calculator being chosen, which these days is a natural choice, use of the cosine formula for the distance and of the cotangent formula for the course is convenient. The cotangent formula cannot be used close to the equator, where the great-circle method is of little or no benefit. Except for this restriction, the formulae can be used in any position.

Despite great-circle sailing having the advantage over Mercator sailing for a shorter distance, the method has certain disadvantages. In some cases, use of the method may lead to a latitude which is too high, and composite sailing has to be used. Discussion of routes and the analysis of the optimum track may start in this subject area and continue in the subject area of voyage planning.

The main objective of this subject area is that the trainee shall gain knowledge and ability in position fixing by using stars and planets.

To compute the altitude of the celestial body, three methods are available:

- the cosine formula and a pocket calculator
- the haversine formula and logarithmic tables
- pre-computed altitude and azimuth tables.

Which of these should be chosen is optional. After having introduced these methods, it is recommended to select one of them and specialize on that particular method. These days, with universal access to inexpensive pocket calculators, the first method may be preferable.

The Marcq St. Hailar's method of position fixing is universal and can be utilized for any celestial body in any direction, the body in the meridian included. It is recommended that position fixing using celestial bodies that are out of the meridian is restricted to this method.

Fixing positions might be carried out as geometrical problems, preferably on an ocean plotting sheet or the navigation chart used (if scale permits).

Composite exercises, including various observation methods, dead reckoning and great-circle sailing, should be a part of the learning process.

The examination of trainees in celestial navigation should be mainly limited to their demonstrating the ability to explain the most common definitions and, in a written examination, to the ability to carry out the calculations related to the various observations.

The variation of water level can be interpreted as being made up of two components, i.e. the astronomic component (tide) and the meteorological component. The tide is predicted to a reasonable accuracy for different ports around the world. The meteorological component cannot be predicted, at least not for longer periods than normal weather prediction. This latter component is added to or subtracted from the predicted height. It is therefore important to emphasize that the predicted height of the tide is not an accurate value.

Satellite navigation systems
At the level of the training for chief mate and master there are two main areas of emphasis in this subject. First, there should be a more thorough treatment of principles, of the limitations of the systems and of the instruments and of the presentation of information than for the watchkeeping officer. Secondly, emphasis should be put on procedures for setting up the instruments, on sources of errors and on the use of corrections and estimation of accuracy. In particular, methods of checking and calibration should be thoroughly covered.

Exercises in the use and calibration of instruments are suitable for group activities.

1.3 Determine and Allow for Compass Errors

1.3.1 THE PRINCIPLES AND ERRORS OF MAGNETIC COMPASSES

Compass error and correction
A mainly qualitative treatment of ship's magnetism and of the deviations that are produced by the components of permanent magnetism and by induction in the notional soft iron rods is required. Given a set of values for the approximate coefficients, trainees should be able to calculate the deviation for a required heading. They should also be able to analyse a table of deviations on suitable headings to obtain the approximate coefficients.

Calculations of the change in value of the coefficients with change of position should be undertaken to demonstrate the effects on deviation of poorly adjusted compasses, particularly the effect of incorrect compensation of coefficient B. Trainees should be aware that a compass adjuster is unable to separate the permanent and induced parts of coefficient B other than by examining the ship's record of deviations. In the absence of such records, as for example with a new ship, the correction is based on the adjuster's experience with similar ships but may prove to be seriously in error when a large change of magnetic latitude is made. The master is better placed to make a correct separation of the two components of coefficient B, especially when a voyage crosses the magnetic equator, where there is no induced B. If coefficient B is made zero there by the use of magnets and if any subsequent error is removed by adjusting the Flinders bar, the compass will have been correctly compensated for the two effects. Trainees should be warned that deviations on other headings should be checked after moving any correctors, since the induction caused by the magnets in the soft iron correctors may have changed.

Practical compass adjusting can be demonstrated on a training ship. Trainees should undertake compass adjustment exercises in a classroom, using a rotatable binnacle with a simulated ship's field. Since only one person at a time can use the binnacle, it will be necessary to make it available for practice outside of timetabled hours. To assist trainees who may be working on their own, a card, listing step-by-step the procedure to follow, should be provided.

Overall the required performance will lead to an officer demonstrating adjustment of the compass by the tentative method, using longitudinal, transverse and vertical permanent magnets, the 'quadrant balls' and Flinder's bar. To this end the following may contribute to the underpinning knowledge for this topic:

1. states the equation for the deviation of a given heading in terms of the coefficients
2. describes the conditions which give rise to each of the coefficients
3. explains the use of the approximate coefficients A, B, C, D and E
4. describes why coefficients A and E may exist at a badly sited compass
5. explains the non-magnetic causes of an apparent coefficient A
6. explains the coefficient B results partly from the ship's permanent magnetism and partly from induced magnetism
7. explains that induced magnetism may also contribute to coefficient C in a badly sited compass
8. Defines the constant lambda λ
9. Defines the constant mu μ.

Although the magnetic compass is mainly used only as a stand-by for the gyro-compass, its errors should be regularly checked and recorded. Readjustment should be carried out when necessary, to ensure that a reliable and predictable instrument is available in the event of failure of the gyro-compass.

1.3.2 THE PRINCIPLES AND ERRORS OF GYRO COMPASSES

Gyro-compass errors and corrections

The instructor should remind trainees that the meridian-seeking property and damping both depend upon detection and measurement of the tilt of the spin axis of the gyroscope resulting from the earth's rotation. That applies equally to compasses controlled by liquid-ballistic attachments and those controlled by electrical signals to torque motors. Any tilt, other than that resulting from the earth's rotation, and any apparent tilt resulting from horizontal acceleration of the compass is a source of error.

The errors and the methods of correcting or limiting them should be treated non-mathematically. The various errors may be referred to the performance standards for gyro-compasses to give trainees an indication of the limits of the accuracy that can be expected.

1.4 Co-Ordinate Search and Rescue Operations

See IMO Model Course No. 1.08 Radar Navigation – Management Level and STCW Reg.I/12

Instructors should note that the International Aeronautical and Maritime Search and Rescue Manual, R31 published jointly by IMO and the International Civil Aviation Organization (ICAO) in three volumes provides guidelines for a common approach to organizing and providing SAR services.

Volume III, Mobile Facilities, is intended to be carried aboard rescue units, aircraft and vessels to help with performance of a search, rescue or on-scene co-ordination function, and with aspects of SAR that pertain to their own emergencies.

1.5 Establish Watchkeeping Arrangements and Procedures

1.5.1 THE INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA

This section will be dealt with mainly by question-and-answer sessions, using models or magnetic boards. Trainees should already be thoroughly familiar with COLREGS and their application, so these sessions will be for the purposes of revision and consolidation. The response "call the master" will, of course, no longer be available to them.

The attention of trainees should be drawn to collision cases and court judgements when discussing their answers and the actions they propose.

When dealing with the use of and manoeuvring in traffic separation schemes, particular attention should be drawn to the proper use of inshore traffic zones where they exist. Exercises should involve planning passages during which it would be necessary to join or to leave lanes, including cases which involve crossing the other lane.

The use of radar for collision avoidance in restricted visibility is covered in IMO Model Course 1.09, Electronic Navigational Aids, but some attention should be paid to the posting of look-outs, the proper use of sound signals, the actions to take on hearing the fog signal of another ship and other matters which do not lend themselves to simulation.

1.5.2 PRINCIPLES TO BE OBSERVED IN KEEPING A NAVIGATIONAL WATCH

Navigational watch

This is based on ensuring that the requirements of STCW regulations and recommendations are complied with. The regulations are contained in the STCW Code Section A-VIII/2.

The references provide examples of strandings which became the subject of official investigations. In most cases, a failure to keep an adequate navigational watch caused or contributed to the accident. A criticism made in a number of cases was the absence of master's standing or special orders and the lack of any routine regarding effective navigational and watchkeeping procedures such as the planning of passages in confined waters and the checking of courses and positions on the chart. In other cases, there was uncertainty about calling the master and confusion about who was conning the ship after the master had come to the bridge.

1.5.3 EFFECTIVE BRIDGE TEAMWORK PROCEDURES

Standards concerning watchkeeping, including organising and managing bridge teams is given in the STCW Code, Chapter VIII. In addition valuable guidance may be found in T24 and T57.

Master and pilot relationship

Reference should be made to the manoeuvring information on board ships. In existing ships the information and presentation may differ from that. The contents of the pilot card can be provided by the master and do not require manoeuvring trials, (V2).

Teamwork

Officers should have sufficient knowledge of the requirements for maintaining an adequate engineering watch to be able to decide, in consultation with the chief engineer, what the composition of the watch should be.

Exercises should include the planning of bunkers and water, taking account of their availability at calls en route, maximum draughts allowed in the load-line zones through which the ship will pass and the need for an adequate reserve for unforeseen emergencies and delays.

The master should inform the chief engineer when he requires under-way watches to be maintained at unsheltered anchorages.

1.6 Maintain Safe Navigation Through the Use of Radar and ARPA and Modern Navigational Systems to Assist in Command Decision-Making

See IMO Model Course 1.08 Radar Navigation – Management Level and STCW Reg I/12

1.7 Forecast Weather and Oceanographic Conditions

1.7.1 SYNOPTIC CHARTS AND WEATHER FORECASTING

The planetary system of wind and pressure

Reference should be made to the way in which the stability of the atmosphere determines the type of cloud, the height at which it forms and its thickness. The stability of the different air masses and how it is modified as they move should be related to the weather associated with them.

A qualitative treatment of the various forces which give rise to surface winds is intended.

Climatology

Trainees should have a general idea of the climate of the oceans and the seasonal changes to be expected. The Mariner's Handbook (T61) contains world climatic charts.

1.7.2 CHARACTERISTICS OF VARIOUS WEATHER SYSTEMS

Tropical revolving storms

The instructor should make use of drawings of the structure of a tropical storm, graphical representations of temperature, pressure and wind speed, satellite pictures and charts showing actual storm tracks.

Trainees should be fully conversant with the means of avoiding tropical storms, where to find details of radio storm warnings and the information which should be transmitted if the master has good reason to believe that a tropical storm is developing or exists in the neighbourhood.

Weather forecasting

If a facsimile receiver is available, receiving and interpreting the weather chart of the day should be part of the training process.

1.7.3 OCEAN CURRENT SYSTEMS

Ocean currents

Trainees should possess sufficient knowledge of ocean currents and sources of information on currents to enable them to select an optimal route for a sea passage and season.

Waves

The dangers of crossing areas of shallow water in heavy weather should be stressed.

If facsimile wave charts of the area are available, trainees should make use of them in weather forecasting.

Ice on the sea

Trainees should know where information on ice reports can be found and understand the terms and descriptions used in them. The Marine Observer's Handbook (T47) and The

Mariner's Handbook (T61) contain the Ice Nomenclature drawn up by the World Meteorological Organization.

Trainees should also recognize the conditions which may give rise to severe accumulation of ice on the ship.

1.8 Respond to Navigational Emergencies

1.8.1 PRECAUTIONS WHEN BEACHING A SHIP

Precautions to be taken when beaching a vessel

Although a gently shelving beach of sand or gravel is ideal, in many cases the urgency of the operation will dictate that the nearest beach is used regardless of the nature of the bottom. Similarly, the state of the tide can seldom be chosen.

A loss of stability similar to that experienced on taking the blocks in dry-dock will occur. If the ship has a large trim or the slope of the bottom is large, a heavy list may develop as the tide falls. The ship will list similarly when one end lifts again on the rising tide. Transfer of ballast or flooding a compartment may be necessary to prevent the list becoming excessive.

Beaching with the ship parallel to the beach may avoid that problem; the ship will settle with a list equal to the slope of the beach. If boats are to be used to transfer passengers or non-essential crew members ashore, the broadside-on position will provide a lee from onshore waves and surf for the boatwork.

On the other hand, a ship end-on to the beach with ground tackle laid out to keep the stern in place would be better able to withstand heavy onshore weather and would be easier to haul off eventually.

1.8.2 ACTIONS TO BE TAKEN IF GROUNDING IS IMMINENT AND AFTER GROUNDING

Grounding

Many of the actions to take after beaching a ship apply also to stranding.

When planning an attempt at refloating, consideration should be given to the extent of damage, the height of the tide, the assistance available and whether the ship can be lightened by discharging ballast or cargo. Soundings, taken from a boat, will give an indication of the most favourable direction in which to try to move the ship during refloating.

The release or probable release of oil or other harmful substances should be reported at once to the nearest coast radio station. Where a serious threat of pollution exists, the coastal State involved may intervene in the salvage operations.

1.8.4 ACTION TO BE TAKEN IF COLLISION IS IMMINENT, AFTER A COLLISION OR IMPAIRMENT OF THE WATERTIGHT INTEGRITY OF THE HULL

Collision

The duties of the master following a collision are set out in the appropriate regulations and annexes.

There may also be national requirements regarding the recording and notification of collision accidents. In any case, full details of the collision, engine and helm orders prior to impact, estimates of the heading and speed at the time of impact and the angle of contact with the other ship should be entered in the log-book for future reference. The trace from the course recorder should be appended to the log-book.

1.8.5 ASSESSMENT OF DAMAGE CONTROL

Even a small hole in the shell plating below the waterline will admit water faster than the capacity of bilge pumps to deal with it. A rapid assessment is needed of the tonnage of water in the space, the lost buoyancy and change of trim and the effect of these factors on stability. Cross-flooding may be needed to reduce the list in certain ships, if only to aid abandonment.

The release or probable release of oil or other harmful substances should be reported to the nearest coast radio station at the first opportunity.

1.8.6 EMERGENCY STEERING

When a ship in a coastal region or area of high traffic density has become disabled as a result of engine or steering failure which cannot readily be repaired, she should report her situation to the coastal State concerned.

It is unlikely that jury steering can be arranged for a large deeply loaded ship, such as a VLCC or a bulk carrier, which would be effective in conditions of strong wind. Recognizing that, the most prudent course of action would be to call for tug assistance at an early stage, before a dangerous situation has developed.

1.8.7 EMERGENCY TOWING ARRANGEMENTS AND TOWING PROCEDURES

Before undertaking a tow, the master should check that he is permitted to do so by the terms of the charter-party or bills of lading. In any case, he should contact the owners for their agreement. They will have to arrange additional insurance.

Towing for the purpose of saving life is always permitted. For example, towing a disabled vessel away from a lee shore may be the safest way of saving the crew in some circumstances.

The master should also be satisfied that the towing operation has a reasonable chance of successful completion. He should consider the relative sizes of the ships, the power of the engines, fuel reserves, equipment available and distance to a safe port.

The towing wires used by salvage tugs are much longer than the towing wires carried by merchant ships, which do not have sufficient weight on their own to provide a catenary to absorb shock loadings. To provide the extra weight it is usual to shackle the towing wire to the anchor cable of the towed ship and to walk back the cable sufficiently to keep the towing wire submerged throughout the towing operation.

When starting to tow, the weight should be taken up gradually, the speed being slowly increased until towing speed is reached. Care should be taken to avoid jerking the tow wire on first taking the weight. The towing speed is adjusted so that the tow wire remains submerged. If the tow wire shows signs of clearing the water and straightening, the engine revolutions should be reduced until a catenary has been restored.

A method of slipping the tow in an emergency (such as the foundering of the towed vessel, for example) should be decided and known to all of the watchkeepers.

Disconnecting the tow, particularly in confined waters at a port approach, can be a critical operation and should be planned and agreed between the two vessels. Speed will have to be reduced gradually over a long distance. As the depth of water decreases, the towed ship should shorten the tow by heaving in cable, to prevent the tow line fouling on the bottom. Harbour tugs should be arranged to assist with manoeuvring during disconnection and to take the tow into a berth. Alternatively, both ships may be brought to anchor before disconnecting.

1.9 Manoeuvre and Handle a Ship in all Conditions

1.9.1 MANOEUVRING AND HANDLING A SHIP IN ALL CONDITIONS

Approaching a pilot vessel

This section can largely be dealt with by discussion led by the instructor. Trainees should be encouraged to contribute, from their own experiences, cases of difficult approaches, problems with embarking a pilot in heavy weather and the slowing of very large ships.

The instructor should impress on trainees that the passage plan should extend to the berth and not finish at the pilot station. The officer in charge of the navigational watch will need the plan to monitor the ship's progress to the berth, (T53).

Ship handling in restricted waters

The approximate mean squat can be calculated by using formulae. Trainees should be reminded that values obtained from the formula or from squat diagrams are theoretical and that the actual squat and trim of their vessels may differ somewhat, (T53, V4, V7).

Constant rate of turn techniques

Such techniques may be demonstrated and practised using a radar simulator. Radar Navigation – Management Level is covered in IMO Model Course 1.08.

Berthing and unberthing

Trainees should demonstrate, with the use of models on a large table, how to berth and unberth at given port facilities, under various conditions of wind and current, detailing the helm and engine orders, anchors, mooring lines and instructions to tugs that they would use. The class should be asked to evaluate and criticize the actions taken and suggest alternative methods where applicable (V5).

Anchoring

Exercises in anchoring are particularly suitable for practice with a training vessel where one is available. Trainees should be required to produce a plan for anchoring in a given position and then carry out the plan, acting as a bridge team. Their roles in the bridge team would be rotated in subsequent exercises. Mention should be made of the importance of checking lateral as well as fore-and-aft movement when anchoring very large ships.

Dry-docking

Stability during dry-docking and the practical implications should be pointed out to trainees.

Handling the ship in heavy weather

Full use should be made of trainee's personal experiences when covering this section. When dealing with methods of keeping a disabled vessel out of a sea trough and lessening lee drift, trainees should be restricted to using materials which are available aboard their ships (V6, V8).

Manoeuvring and propulsion characteristics

Draw attention to the warning in the manoeuvring booklet and the wheelhouse poster that the performance of the ship may differ from that shown, due to environmental, hull and loading conditions. Also point out that much of the information is estimated; for example, the manoeuvring characteristics in wind. Records of actual behaviour, together with the conditions in which they were observed, form a valuable addition to the manoeuvring booklet. Opportunities for determining characteristics arise, for example, when approaching pilot stations or anchoring to await a tide or berth (R17).

Navigating in or near ice

The Mariner's Handbook (T61) contains a full treatment of ice conditions, well illustrated with photographs

1.10 Operate Remote Controls of Propulsion Plant and Engineering Systems and Services

1.10.1 OPERATING PRINCIPLES OF MARINE POWER PLANTS

Marine power plants

Diesel engines

The principles of the working of 2-stroke and 4-stroke diesels should be covered, together with their essential services such as fuel, lubricating and cooling systems. Details of particular makes of engines are not required. Trainees should be aware of the procedures for preparing the engine for use and the change-over from full sea speed to manoeuvring, with the likely times involved. They should also know what is involved in starting and controlling the engine.

The rules regarding the capacity of the starting air reservoir are laid down by the classification societies.

Steam turbine systems

The boiler, feed system and turbine should be treated as a single main propulsion system. Trainees should be able to produce schematic drawings of the complete system and explain the purpose of the various parts. Details of particular makes of equipment are not required. Trainees should be aware of those faults which lead to automatic shut-down. The procedures and time taken to raise steam and prepare the engine for manoeuvring and the procedures for controlling a steam turbine engine should be known.

Propeller and propeller shaft

The bridge control for controllable-pitch propellers is usually arranged to give about 60 to 70 per cent of engine full speed when set for zero pitch. Movement of the lever forward or aft initially affects the pitch only. Full pitch is usually reached by moving the control lever through half of its travel, further movement increasing the engine revolutions. There may also be a means of adjusting the maximum pitch available. The engine and CPP can be controlled from the machinery control room and facilities may be provided for overriding all remote controls. Standing orders should lay down the procedure for informing the bridge if this has to be done.

Before starting the main engine, the propeller pumps should be running and a check made that control is possible from all control positions. During starting, control will be from the machinery control room. The propeller should be set for zero thrust and a check made that it is all clear to start the propeller turning. After starting, control is transferred to the bridge.

Before letting go or weighing anchor, the officer of the watch should check which position has control, and that it is effective, by making a small movement of the pitch control and observing the result. Before entering harbour or restricted waters, a check should be made on the control of engine speed and propeller pitch while sea rom is still available.

Throughout this section instructors should keep in mind that officers should be able to explain the principles of operating and maintaining marine power plants. Officers should be familiar with the correct and commonly used engineering terminology in this context. The officer must have sufficient knowledge to be able to understand and manage the issues – he therefore does not need to have a detailed engineering knowledge. It is important that he understands the consequences of any malfunctioning and the actions to be taken to restore proper operations, or avoid problems if the machinery cannot be restored.

Bridge control
Technical details are not required. Trainees should be able to draw block diagrams of the systems, showing the information paths between the various components. The requirements for bridge indicators and alarms and the emergency stop are set out in SOLAS Regulations.

1.10.2 SHIPS' AUXILIARY MACHINERY

This section deals with machinery and equipment other than the main propulsion, although some of the equipment would be necessary to keep the main engine running; for example, pumps.

Trainees should be able to draw simple line drawings of boilers and heat exchangers. Today, when most ships are equipped with diesel main engines, their use is restricted to providing ship's services. In tankers, the use of steam is important for heating cargo and for the driving of cargo pumps.

Instructors should keep in mind that officers should be able to explain the principles of operating and maintaining auxiliary machinery. Officers should be familiar with the correct and commonly used engineering terminology in this context. The officer must have sufficient knowledge to be able to understand and manage the issues – he therefore does not need a detailed engineering knowledge. It is important that he understands the consequences of any malfunctioning and the actions to be taken to restore proper operations, or avoid problems if the machinery cannot be restored.

Distillation and fresh-water systems
The production of fresh water from seawater in sufficient quantities enables a ship to carry a larger deadweight of cargo and ensures a supply of water free from dissolved salts for the boiler feed. The temperature at which flash evaporators work is not high enough to sterilize water for drinking purposes. Evaporators should not be run for the production of drinking water in coastal areas because of the risk of biological contamination. In any case, water from distillers or evaporators must be treated before it is safe to drink.

As an alternative to traditional distillation methods, reverse osmosis process may be used for generating fresh water at sea and should be mentioned.

Pumps and pumping systems
Trainees should have a qualitative knowledge of the losses in a pumping system and the characteristic curve for centrifugal pumps. They should also understand net positive suction head and realize that, when it approaches zero, gassing will occur at the pump, leading to cavitation which may cause damage to the impellers of centrifugal pumps.

Steering gears
The operation of ram and rotary-vane hydraulic steering gears and how the power required is supplied by variable-delivery pumps should be known. Trainees should also be able to explain how the SOLAS requirements for auxiliary steering and emergency control of steering gear are

met. They should also be aware of the requirements for testing the steering gear and having drills in the change-over to auxiliary steering gear. Records of the tests and drills should be entered in the log-book.

Generators, alternators and electrical distribution
Trainees should have a qualitative understanding of electrical generation and distribution, including the connection between the main and emergency switchboard during normal operation. The treatment of A.C. motors is confined to the induction motor, which is the only type found aboard most ships.

The considerations in loading generators and parallel operations may be covered.

During charging, lead-acid batteries evolve hydrogen, which is easily ignited over a wide range of concentration. The electrolytes of both acid and alkaline batteries are highly corrosive to many materials and to the person. In addition, there is a risk of electric shock from large installations such as the transitional sources of electrical power.

Refrigeration, air-conditioning and ventilation
Trainees should be able to sketch a vapour-compression-cycle refrigeration system and explain what happens at the various components. The coefficient of performance is defined as the rate of heat extraction at the evaporator divided by the power used to circulate the refrigerant. It is a measure of the plant efficiency but, since its value is greater than one, the term 'coefficient of performance' is used instead of 'efficiency'. Trainees should deal with refrigerated cargo systems. The arrangements can be considered in three parts; the central primary refrigeration plant, the brine circulating system and the air circulating system for cooling the holds.

Mechanical ventilation systems for ships' holds often incorporate remote-reading dewpoint sensors and drying units for the circulated air to maintain the dewpoint in the hold below the temperature of the cargo and of its steelwork, so as to prevent condensation damage.

Stabilizers
The quantity of water and the setting of the control valves of flume stabilizers need to be adjusted to the ship's condition of loading, which determines its natural rolling period. Adjustment may be necessary after an alteration of course which produces a large change in wave encounter period.

Sewage treatment plants
The discharge of untreated sewage into coastal waters is prohibited by some countries and most port authorities. Ships will then either have to retain sewage aboard for subsequent discharge to shore facilities or more than 12 miles from the nearest land, or be equipped with an approved sewage plant producing an effluent which can be discharged anywhere. The latter would require a biological treatment plant. Discharges from an approved chemical treatment plant would be permitted when more than four miles from the nearest land.

Oily-water separators and oil filtering equipment
The term 'separator', as used in the regulations for preventing pollution by oil, means equipment which reduces the oil content below 100 ppm even if it uses filters to achieve that level. 'Oil filtering equipment' refers to equipment which reduces the oil content to 15 ppm or less.

The approval for an oily-water separator includes the pump supplying it. No other pump should be used with it. Even when used correctly, a separator may fail to reduce the oil content to the required limits if the oil is emulsified or the water contains a lot of particulate matter to which the oil adheres.

Incinerators
An incinerator can be used to burn residual oil and sludge collected from oil purifiers and the oily-water separator. It can also be used for the disposal of sewage sludge and rubbish. A ship fitted with an incinerator may not be dependent on the availability of shore reception facilities.

Deck machinery
The requirements for windlasses vary between the classification societies, but, basically, require that:

- the windlass brakes are able to control the running anchor and cable when letting go;
- the windlass can heave a specified weight of cable and anchor at a specified speed, typically between 4 and 6 times the weight of one anchor at a speed of between 0.12 and 0.2 m/s.

Hydraulic systems
The majority of marine hydraulic systems are medium-pressure systems and may be either open- or closed-circuit.

Accumulators damp out fluctuations in pressure which may occur in the pressure line. They may also be used to provide a small store of pressurized fluid which can be used in an emergency. One example is for the closing of watertight doors after power to the hydraulic pump has been lost.

Hydraulic systems also contain nonreturn valves, to prevent reverse flow, and pressure-control valves, including pressure-relief valves.

Hydraulic steering gear provides an example of a variable-stroke pump acting as controller and power supply.

Dirt or sediment in a system causes abrasion of moving parts and blockage of control valves, leading to a failure of the machinery. Filters are fitted at pump suctions and upstream of control valves. When any part of the system is disconnected for repair or replacement, it is important to cover and seal openings through which dust or water could enter. Hydraulic systems should not be opened up or reassembled when other work in the vicinity is creating dirty conditions.

1.10.3 GENERAL KNOWLEDGE OF MARINE ENGINEERING TERMS
Some of the terms listed in the syllabus may already have been covered in the teaching of Physical Science.

Marine engineering terms and fuel consumption
when using the fuel coefficient to estimate fuel requirements for a passage, it should be remembered that the value of the constant depends to some extent on the roughness of the hull.

A ship lying in water of high temperature for some time may attract considerable fouling of the hull and propeller, resulting in increased fuel consumption during the subsequent passages. Generally, performance falls off with time since the previous dry-docking. Clearly, the state of maintenance of the engine also affects fuel consumption.

When it is known that the ship cannot be berthed or is not required before a certain time at the next port, fuel may be saved by reducing speed, to arrive shortly before the required time, rather than proceeding at full speed and waiting at anchor.

Part C1: Detailed Teaching Syllabus

Introduction

The detailed teaching syllabus is presented as a series of learning objectives. The objective, therefore, describes what the trainee must do to demonstrate that the specified knowledge or skill has been transferred.

Thus each training outcome is supported by a number of related performance elements in which the trainee is required to be proficient. The teaching syllabus shows the *Required performance* expected of the trainee in the tables that follow.

In order to assist the instructor, references are shown to indicate IMO references and publications, textbooks and teaching aids that instructors may wish to use in preparing and presenting their lessons.

The material listed in the course framework has been used to structure the detailed teaching syllabus; in particular,

Teaching aids (indicated by A)
IMO references (indicated by R) and
Textbooks (indicated by T)

will provide valuable information to instructors.

Explanation of Information Contained in the Syllabus Tables

The information on each table is systematically organised in the following way. The line at the head of the table describes the FUNCTION with which the training is concerned. A function means a group of tasks, duties and responsibilities as specified in the STCW Code. It describes related activities which make up a professional discipline or traditional departmental responsibility on board.[1]

In this Model Course there are three functions:

Navigation at the Management Level
Cargo Handling and Stowage at the Management Level
Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

The header of the first column denotes the **COMPETENCE** concerned. Each function comprises a number of competences. For example, the Function 1, Navigation at the Management Level, comprises a total of ten COMPETENCES. Each competence is uniquely and consistently numbered in this model course.

The first is **Plan a Voyage and Conduct Navigation.** It is numbered 1.1, that is the first competence in Function 1. The term competence should be understood as the application of

1 Morrison, W.S.G. Competent crews = safer ships. Malmö, WMU Press, 1997 (ISBN 91-973372-0-X)

knowledge, understanding, proficiency, skills, experience for an individual to perform a task, duty or responsibility on board in a safe, efficient and timely manner.

Shown next is the required TRAINING OUTCOME. The training outcomes are the areas of knowledge, understanding and proficiency in which the trainee must be able to demonstrate knowledge and understanding. Each COMPETENCE comprises a number of training outcomes. For example, the competence **Plan a Voyage and Conduct Navigation** comprises a total of ten training outcomes. The first is in VOYAGE PLANNING AND NAVIGATION FOR ALL CONDITIONS. Each training outcome is uniquely and consistently numbered in this model course. That concerned with Voyage Planning and Navigation for all Conditions is uniquely numbered 1.1.1. For clarity training outcomes are printed in black on grey, for example TRAINING OUTCOME.

Finally, each training outcome embodies a variable number of Required performances – as evidence of competence. The instruction, training and learning should lead to the trainee meeting the specified Required performance. For the training outcome Voyage Planning and Navigation for all Conditions, there are two areas of performance. These are:

1.1.1.1 Log Books
1.1.1.2 Navigation Planning for all Conditions

Following each numbered area of Required performance there is a list of activities that the trainee should complete and which collectively specify the standard of competence that the trainee must meet. These are for the guidance of teachers and instructors in designing lessons, lectures, tests and exercises for use in the teaching process. For example, under the topic 1.1.1.2 Navigational Planning for all Conditions, to meet the Required performance, the trainee should be able to:

- plan navigation in restricted waters by day, using terrestrial observations ...
- plan navigation in restricted waters by night ...
- plan navigation in restricted visibility ...

and so on.

IMO references (Rx) are listed in the column to the right hand side. Teaching aids (Ax), videos (Vx) and textbooks (Tx) relevant to the training outcome and required performances are placed immediately following the TRAINING OUTCOME title.

It is not intended that lessons are organised to follow the sequence of Required performances listed in the Tables. The Syllabus Tables are organised to match with the competence in the STCW Code Table A-II/2. Lessons and teaching should follow college practices. It is not necessary, for example, for celestial navigation to be studied before tides. What is necessary is that <u>all</u> the material is covered and that teaching is effective to allow trainees to meet the standard of the Required performance.

COMPETENCE 1.1	Plan a Voyage and Conduct Navigation	IMO Reference

TRAINING OUTCOMES: STCW Code Table A-II/2

Demonstrates a knowledge and understanding of

1.1.1 VOYAGE PLANNING AND NAVIGATION FOR ALL CONDITIONS

1.1.2 ROUTEING IN ACCORDANCE WITH THE GENERAL PRINCIPLES ON SHIP'S ROUTEING

1.1.3 REPORTING IN ACCORDANCE WITH THE GUIDELINES AND CRITERIA FOR SHIP REPORTING SYSTEMS

COMPETENCE 1.1	Plan a Voyage and Conduct Navigation	IMO Reference

1.1.1 VOYAGE PLANNING AND NAVIGATION FOR ALL CONDITIONS

Textbooks: T3, T24
Teaching aids: A1, A2, A3, A8, A10, A13, A14, A15, A16, A17, A18, A19, A20, A21, A22, A23

Required performance:

1.1 Log Books (3 hours) — R1

- keeps a proper log in accordance with maritime shipping acts and other laws and regulations

1.2 Navigation Planning for all Conditions (20 hours) — R1, R3

- plans navigation in restricted water by day, using terrestrial observations such as bearings of lighthouses, beacons and buoys in conjunction with appropriate charts, sailing directions and other publications
- plans navigation in restricted waters by night, using the same navigation means as in the above objective but with special emphasis on the characteristics, colours and sectors of lights
- plans navigation in restricted visibility, with special emphasis on navigation in coastal waters and in areas of heavy traffic, including the use of radar, with its possibilities and limitations
- plans navigation in traffic separation schemes in accordance with routeing instructions
- plans navigation in ice
- plans navigation in areas of extensive tidal effects
- determines the change of date on crossing the international date line

1.1.2 ROUTEING IN ACCORDING WITH THE GENERAL PRINCIPLES ON SHIP'S ROUTEING

Textbooks: T2, T3
Teaching aids: A1, A3, A11, A12, A13, A23, A24

Required performance:

2.1 Routeing (15 hours) — R2, R3

- uses Ocean Passages for the World
- uses pilot charts and other publications such as sailing directions, Notices to Mariners and the like to determine areas of ice and iceberg danger
- uses pilot charts and other information sources to determine areas in which visibility is likely to be reduced

COMPETENCE 1.1	Plan a Voyage and Conduct Navigation	IMO Reference

- demonstrates an ability to choose select a route, taking into account distance, wind, sea states, current, ice, icebergs, bad visibility, the nature of the cargo, load lines, crew agreements etc.
- explains the principles of Weather Routeing

1.1.3 REPORTING IN ACCORDANCE WITH THE GUIDELINES AND CRITERIA FOR SHIP REPORTING SYSTEMS)

Textbooks: T3
Teaching aids: A1, A3

Required performance:

3.1 Ship Reporting Systems (1 hour)

R2 Reg. V/8-1
R3

- explains the guidelines and criteria for ship reporting systems
- makes reports in accordance with published guidelines and criteria

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

TRAINING OUTCOME:

STCW Code
Table A-II/2

Demonstrates a knowledge and understanding of:

1.2.1 POSITION DETERMINATION IN ALL CONDITIONS

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

1.2.1 POSITION DETERMINATION IN ALL CONDITIONS

Textbooks: T1, T2, T3, T4, T13, T14, T59
Teaching aids: A1, A2, A4, A5, A6, A7, A8, A9, A10, A16, A17, A18, A26, A30

Required performance:

1.1 Terrestrial Navigation (24 hours) — R1

- explains and classifies chart projections by construction methods, properties and characteristics
- explains the values of conformal (orthomorphic) charts in navigation
- describes gnomonic, Mercator and Transverse Mercator projections and the Universal Transverse Mercator system
- states the Mercator sailing formula
- uses the Mercator formula to calculate course and distance between two positions
- uses the Mercator formula to calculate the final position, given the initial position, course and distance
- explains why a navigation problem should be solved by using a Mercator sailing in preference to plane sailing because of the distance involved
- explains how errors may occur in position fixing, and explains how to minimise the probability of errors
- demonstrates how erroneous position lines influence the positions

1.2 Great-Circle Sailing (10 hours) — R1

- defines a great circle on the earth's surface and its vertex
- calculates initial course and distance of a great-circle track
- calculates the position of the vertex
- calculates intermediate positions on the great circle and the course at these points
- calculates the distance and time to sail per 1° change of course
- calculates composite sailing
- demonstrates the use of gnomonic charts for plotting the great circle between two points
- transfers the great circle to a Mercator chart
- finds and applies the half convergency correction to a great-circle bearing to obtain the Mercator bearing to plot
- defines the curve of constant bearing and calculates the direction of the position line in the vicinity of the D. R. Position

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

1.3 Celestial Navigation (24 hours) — R1

- classifies stars by apparent magnitude
- recognizes stellar constellations as seen from the earth
- states Kepler's laws of planetary motion and defines the terms perihelion, aphelion and eccentricity
- determines the hour angle and declination of the planets
- determines the time of visible rising and setting of the sun by use of the Nautical Almanac
- determines the azimuth and hour angle of true rising and setting of the sun
- defines the concepts of civil, nautical and astronomical twilight and their significance
- explains the influence of latitude on the duration of twilight, including the conditions necessary for twilight all night, continuous daylight or continuous darkness
- calculates the time of meridian altitude of the planets and stars
- applies altitude corrections for the planets and stars
- explains the relation between time and longitude and between time and hour angle
- calculates position lines by means of all of the celestial bodies in any position
- chooses stars suitable for observation in the twilight period
- identifies stars by means of a star chart, a star finder and by calculation (declination of the star)

1.4 Tides (10 hours) — R1

- explains the general theory of tides
- explains in basic terms the methods of predicting tides
- explains the non-astronomical component of sea level
- explains other irregularities of the tide
- states that the predicted tide level is not an accurate value
- demonstrates the use of tide tables
- determines height and time for high and low water in secondary ports
- determines the predicted height of water at a given time in a tabulated port
- determines the predicted time for a given tide level
- demonstrates the use of tidal stream charts
- defines the zero level of the charts

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

1.5 Loran-C System (6 hours) — R1

- describes the principles of time difference used in the Loran-C system
- shows how ambiguity occurs when two radio stations are transmitting signals simultaneously
- explains how ambiguity can be removed by application of a time delay
- describes the pulsing system and cycle matching used in the Loran-C system
- explains the possibility of sky wave interference and use of extended mode
- states the approximate accuracy and explains how it varies
- explains a coverage diagram for a Loran-C chain
- states the limitations of the system and the reason for frequent checking
- states the areas of the world covered by the Loran-C system

1.6 Satellite Navigation Systems (6 hours) — R1, R6

- describes the principle on which the Global Positioning System (GPS) operates
- describes the configuration of satellite orbits and the periods of the satellite vehicles (SVs)
- states that at least four SVs at a usable elevation should be visible to the receiving antenna at any point on the earth's surface at any time
- states that SV positions are accurately controlled from the ground Master Control Station
- states that the Master Control Station also provides data which are sent to the SVs, stored and later transmitted as a data frame to receiving stations for use in calculating position
- explains what is meant by 'pseudo-random noise' codes (PRN codes)
- describes briefly the two codes which are transmitted
- explains why two frequencies are used
- states that civilian sets will probably work on one frequency, using the 'course and acquire' code (C/A code) only
- explains why an extremely stable clock is essential in the SV, while a less stable one is acceptable in the receiver
- describes briefly how pseudo-ranges are measured by matching the received code with the same locally generated code
- explains why the measurement is not a true range
- states that simultaneous pseudo-ranges to three SVs are sufficient to fix the position of the earth's surface and determine the receiver clock error from GPS time but four are required to obtain height
- lists and describes the main sources of error in the determined position
- states that the system is expected to have an accuracy of about 100 metres (95% probability)

COMPETENCE 1.2	Determine Position and the Accuracy of Resultant Position Fix by any Means	IMO Reference

- states that measured Doppler shifts can be processed to provide speed and direction outputs

COMPETENCE 1.3	Determine and Allow for Compass Errors	IMO Reference

TRAINING OUTCOMES:

STCW Code
Table A-II/2

Demonstrates a knowledge and understanding of:

1.3.1 THE PRINCIPLES AND ERRORS OF MAGNETIC COMPASSES

1.3.2 THE PRINCIPLES AND ERRORS OF GYRO COMPASSES

1.3.3 SYSTEMS UNDER THE CONTROL OF THE MASTER GYRO AND THE OPERATION OF THE MAIN TYPES OF GYRO-COMPASSES IN USE AT SEA

COMPETENCE 1.3	Determine and Allow for Compass Errors	IMO Reference

1.3.1 THE PRINCIPLES AND ERRORS OF MAGNETIC COMPASSES

Textbooks: T34, T46
Teaching aids: A1, A27

Required performance:

1.1 Magnetic Compass Error and Correction (25 hours)

R2, Ch. V
Reg. 12
R6

- explains how a ship acquires its permanent magnetic field
- explains how the ship's permanent magnetic field may be resolved into three components, designated P, Q and R
- explains how the ship's induced magnetism may be represented by soft iron rods
- defines the approximate coefficients A, B, C, D and E
- states the equation for the deviation of a given heading in terms of the coefficients
- describes the conditions which give rise to each of the coefficients
- explains the use of the approximate coefficients A, B, C, D and E
- describes why coefficients A and E may exist at a badly sited compass
- explains the non-magnetic causes of an apparent coefficient A
- explains that coefficient B results partly from the ship's permanent magnetism and partly from induced magnetism
- explains that induced magnetism may also contribute to coefficient C in a badly sited compass
- describes how the deviation associated with the coefficient permanent B varies with magnetic latitude
- describes how the deviation associated with the coefficient induced B varies with magnetic latitude
- explains why the deviation due to permanent magnetism should be compensated by permanent magnets and that due to induced magnetism by soft iron correctors, where possible
- describes the causes of heeling error and how it varies with heel, course and magnetic latitude
- describes the correction of heeling error and why the correction does not remain effective with change of magnetic latitude
- defines the constant lambda λ
- defines the constant mu μ
- explains how the soft iron spheres increase the mean directive force towards magnetic north and that the value of λ with the spheres in place is called the ship's multiplier ($\lambda 2$)
- describes the vertical force instrument and its use in correcting heeling error
- describes methods of obtaining a table of deviations
- analyses a table of deviations to obtain approximate coefficients

COMPETENCE 1.3	Determine and Allow for Compass Errors	IMO Reference

- states that anything which could affect the deviation of the compass should be stowed in its sea-going position before correcting it
- carries out an adjustment of the compass by the tentative method and obtains a table of residual deviations
- states the order in which corrections should be made and explains why they are made in that order
- describes how heeling error may produce an unsteady compass on certain headings after a large change of magnetic latitude and how to deal with it
- explains why a large coefficient B may appear after a large change of magnetic latitude and how to correct it
- describes how sub-permanent magnetism gives rise to retentive error
- explains how the components of coefficient B may be adjusted tentatively during the course of the voyage
- states that deviations may be affected by cargo of a magnetic nature, the use of electro-magnets for cargo handling, or repairs involving hammering or welding of steelwork in the vicinity of the compass
- states that requirements for the carriage of magnetic compasses as set out in SOLAS
- outlines the performance standards for magnetic compasses
- explains the importance of keeping a record of observed deviations

1.3.2 THE PRINCIPLES AND ERRORS OF GYRO COMPASSES

Textbooks: T34, T59
Teaching aids: A1, A29

Required performance:

2.1 Gyro-Compass Errors and Corrections (10 hours) — R1

- explains the meaning of the term 'free gyroscope' and the properties 'gyroscopic inertia' and 'precession'
- explains how a free gyroscope is made north seeking under the influence of gravity control
- explains why a gyro-compass that is damped in tilt will settle with its spin axis at a small angle to the meridian, except when at the equator
- states that the resulting error is known as latitude error or damping error and varies directly as the tangent of the latitude
- states that latitude error can be removed by a manual setting that mechanically moves the lubber line and the follow-up system to show the correct heading
- explains, that in gyro-compasses without liquid ballistic control, a signal that is proportional to the sine of the latitude, and which is set by manual control, is injected to maintain the compass in the meridian
- states that compasses damped in azimuth settle in the meridian and are free from latitude error

COMPETENCE 1.3 Determine and Allow for Compass Errors **IMO Reference**

- states that course and speed error is caused by the tilting of the spin axis, resulting from the ship's motion over the surface of the earth
- states that the rate of tilting, in minutes of arc per hour, is equal to the north-south component of the ship's velocity
- explains how the tilt causes precession in azimuth to the west on northerly headings and to the east on southerly headings in compasses with liquid ballistic control
- derives the equation for course and speed (velocity) error from a vector triangle of velocities
- states that the velocity error is removed by manual settings of latitude and speed to offset the lubber line and the follow-up system in liquid-controlled compasses
- explains how the correction is made in compasses that employ other methods of detecting tilt
- states that ballistic deflection results from changes in the ship's north-south component of velocity
- explains the behaviour of a liquid ballistic during a change of speed or an alteration of course
- explains that the precession resulting from ballistic deflection may be arranged to move the compass to the correct settling position, after allowance for the change in course and speed error, by choosing a suitable period for the compass
- explains that the relationship in the above objective is exact for one latitude only, usually 45°, and that there is a small wander of the compass to the final settled position in other latitudes
- explains that the pendulum of a tilt detector will be thrown out of the vertical during a change of course or speed, producing an error in its output
- explains that the method used in the above objective is not applicable for compasses without liquid ballistic control since course and speed error is fully corrected for all headings
- explains that errors are limited by damping the pendulum and limiting the applied torque for large deflections of the pendulum
- states that the sensitive element of a gyro-compass is made such that its moment of inertia about any axis is the same, thus preventing any tendency to turn when swinging pendulously as a result of rolling or pitching
- describes the effect of rolling on a liquid ballistic for various ship's headings
- explains why the movement of the liquid causes an error except on the cardinal headings
- explains how intercardinal rolling error is reduced to negligible proportions
- states that intercardinal rolling error does not occur in compasses having no gravitational control attachments to the gyroscope
- states that errors caused by acceleration of the compass during rolling and pitching can be reduced by siting the master compass low down, near the rotational centre of the ship
- outlines the performance standards for gyro-compasses R7

COMPETENCE 1.3	Determine and Allow for Compass Errors	IMO Reference

1.3.3 SYSTEMS UNDER THE CONTROL OF THE MASTER GYRO AND THE OPERATION OF THE MAIN TYPES OF GYRO-COMPASSES IN USE AT SEA

Textbooks: T34, T59
Teaching aids: A1, A29

Required performance:

R1

3.1 Systems Under the Control of the Master Gyro and the Operation of the Main Types of Gyro-compasses in Use At Sea (2 hours)

- defines the main systems under the control of the master gyro
- defines the main types of gyro-compass in use at sea
- refers to manufacturers' manuals to determine necessary maintenance tasks

COMPETENCE 1.4	Co-ordinate Search and Rescue Operations	IMO Reference

TRAINING OUTCOME:

Demonstrates a knowledge and understanding of: STCW Code Table A-II/2

1.4.1 THE PROCEDURES CONTAINED IN IMO MERCHANT SHIP SEARCH & RESCUE MANUAL (MERSAR) R30, R31

1.4.1 THE PROCEDURES CONTAINED IN IMO MERCHANT SHIP SEARCH AND RESCUE MANUAL (MERSAR)

Textbooks:
Teaching aids: A1

Required performance:

1.1 As per IMO Model Course 1.08 for Radar Navigation – Management Level R1

COMPETENCE 1.5	Establish Watchkeeping Arrangements and Procedures	IMO Reference

TRAINING OUTCOMES:

STCW Code
Table A-II/2

Demonstrates a knowledge and understanding of:

1.5.1 THE INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA

1.5.2 PRINCIPLES TO BE OBSERVED IN KEEPING A NAVIGATIONAL WATCH

1.5.3 EFFECTIVE BRIDGE TEAMWORK PROCEDURES

COMPETENCE 1.5	Establish Watchkeeping Arrangements and Procedures	IMO Reference

1.5.1 THE INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA

Textbooks:
Teaching aids: A1

Required performance:

1.1 COLREGS 1972 and Amendments (30 hours) — R1, R8, R15, R16

- identifies the lights and shapes by any type of vessel and their meaning, including the additional signals for fishing vessels fishing in close proximity
- demonstrates, with the use of models displaying proper signals or lights, a navigation light simulator or otherwise, the proper action to take to avoid collision with other vessels in sight
- demonstrates how to determine the risk of collision and the proper action to take to avoid collision in restricted visibility
- describes fully the use of, and manoeuvring in, traffic separation schemes

1.5.2 PRINCIPLES TO BE OBSERVED IN KEEPING A NAVIGATIONAL WATCH — STCW Code Section A-VIII/2 Part 3-1

Textbooks:
Teaching aids: A1

Required performance:

2.1 Navigational Watch (2 hours)

- states that the officer of the watch is responsible for navigating safely with particular regard to avoiding collision and stranding
- lists factors to be taken into account when deciding the composition of the watch on the bridge
- states that watch duties should be so arranged to comply with rest periods prescribed in the STCW Code
- states watch schedules must be posted and accessible
- plans an intended voyage taking into account weather and ice conditions, tidal streams, traffic separation schemes and other navigational factors
- states that the master should ensure that officers in charge of watches know the location and operation of all navigational and safety equipment and can take account of the operating limitations of such equipment
- states that the officer in charge of a navigational watch should not be assigned or undertake any duties which interfere with the safe navigation of the ship
- writes standing orders for a deck watch at anchor and a navigational watch underway

COMPETENCE 1.5	Establish Watchkeeping Arrangements and Procedures	IMO Reference

1.5.3 EFFECTIVE BRIDGE TEAMWORK PROCEDURES

STCW Code
Section A-VIII/2
Part 3-1

Textbooks: T24, T57
Teaching aids: A1, V2

Required performance:

3.1 Bridge Teamwork Procedures (3 hours)

R1, R7

Master/Pilot Relationship

- states why the master and pilot should agree on plans and procedures for the intended voyage
- states that any special conditions of weather, tidal currents, depth or marine traffic which may be expected should be discussed
- states that the master should provide the pilot with the pilot card and make available the manoeuvring booklet or, in their absence, provide him with details of the ship's particulars and manoeuvring characteristics, including information on the ship's response to wind forces; special characteristics related to squat should be discussed
- states that the master should inform the pilot of any unusual handling characteristics, machinery difficulties or problems with navigational equipment which could affect the operation, handling of safe manoeuvring of the ship
- states that the pilot should give information on the intended use of tugs, if any
- states that the master and pilot should discuss, if applicable, special consideration concerning passing or overtaking of other vessels in narrow channels

3.2 Bridge Team Management (3 hours)

R1

- explains the benefits of effective disposition of manpower on the bridge
- gives examples of error chains and explains how they can be avoided
- draws up contingency plans for routine manoeuvres
- explains the importance of effective internal and external communication
- explains the need for adequate information flow between team members
- explains that failure to monitor the ship's position and communicate effectively has lead to casualties

3.3 Teamwork (2 hours)

R1
STCW Code
Section A-VIII/2
Part 3-1

- explains the need for effective planning including:
  time constraints
  required navigational route
  need to monitor external communications
  makes allowance for traffic density
  makes provision for integrating the pilot into the bridge team
  prevailing weather conditions
- explains effective management of resources includes personnel, equipment and time

COMPETENCE 1.5	Establish Watchkeeping Arrangements and Procedures	IMO Reference

- understands the importance of correctly handing the conn between members of the bridge team including the pilot.
- recognises the risk factors involved with a planned passage.
- explains the need for effective flow of information

COMPETENCE 1.6	Maintain Safe Navigation Through the Use of Radar and ARPA and Modern Navigation Systems to Assist Command Decision-making	IMO Reference

TRAINING OUTCOMES:

STCW Code Table A-II/2

Demonstrates a knowledge and understanding of:

1.6.1 SYSTEM ERRORS AND OPERATIONAL ASPECTS OF MODERN NAVIGATION SYSTEMS INCLUDING RADAR AND ARPA

1.6.2 BLIND PILOTAGE TECHNIQUES

1.6.3 EVALUATION OF NAVIGATIONAL INFORMATION TO AID IN COMMAND DECISIONS FOR AVOIDING COLLISION AND SAFE NAVIGATION OF THE SHIP

1.6.4 INTER-RELATIONSHIP AND OPTIMUM USE OF ALL NAVIGATIONAL DATA

See IMO Model Course 1.08 for Radar Navigation – Management Level

COMPETENCE 1.7	Forecast Weather and Oceanographic Conditions	IMO Reference

STCW Code
Table A-II/2

TRAINING OUTCOMES:

Demonstrates a knowledge and understanding of:

1.7.1 SYNOPTIC CHARTS AND WEATHER FORECASTING

1.7.2 CHARACTERISTICS OF VARIOUS WEATHER SYSTEMS

1.7.3 OCEAN CURRENT SYSTEMS

1.7.4 CALCULATION OF TIDAL CONDITIONS

1.7.5 APPROPRIATE NAVIGATIONAL PUBLICATIONS ON TIDES AND CURRENTS

COMPETENCE 1.7	Forecast Weather and Oceanographic Conditions	IMO Reference

1.7.1 SYNOPTIC CHARTS AND WEATHER FORECASTING

Textbooks: T47, T48
Teaching aids: A1

Required performance:

SYNOPTIC METEOROLOGY

1.1 The Planetary System of Wind and Pressure (2 hours) R1

- explains, qualitatively with the aid of sketches, the circulation cells which would exist on a rotating earth, not inclined to its orbit of rotation about the sun, and with a homogeneous surface
- compares the actual wind and pressure distribution with the above
- draws the global mean surface pressure distribution together with the oceanic wind for January and July.
- describes the characteristics and location of the doldrums, ITCZ, Trade Winds, Sub tropical oceanic highs, westerlies and polar easterlies
- defines the 'Monsoon Regime'
- states the areas which experience a true monsoon regime
- applies previous concepts to a qualitative explanation of the causes of monsoon regimes
- applies previous concepts to a qualitative explanation of the weather associated with the January and July monsoons of the Indian Ocean, China sea, North Coast of Australia and West Coast of Africa
- explains qualitatively the monsoon type weather along the North East coast of Brazil

1.2 The Weather Associated with the Principal Air Mass Types (2 hours) R1

- analyses qualitatively the formation of an air mass
- explains the significance of a Source Region
- describes the characteristics of a region acting as the source region for an air mass
- discriminates between the source region characteristics if Arctic Maritime and Continental Air, Polar Maritime and Continental Air, Tropical Maritime and Continental Air, and Equatorial Air
- describes the subsequent modification of an air mass by the nature of the surface over which it travels
- defines stable and unstable air masses
- determines typical synoptic patterns associated with air mass types
- interprets qualitatively the weather associated with air mass types

COMPETENCE 1.7	Forecast Weather and Oceanographic Conditions	IMO Reference

1.3 Synoptic and Prognostic Charts and Forecasts From Any Source (2 hours) — R1

- interprets the isobaric patterns of a synoptic weather chart with interpolation and extrapolation as necessary
- determines the geostrophic and approximate surface wind speeds from the chart by use of the geostrophic wind scale
- determines the weather associated with specific places within the plots
- applies the rules governing the movement of pressure systems, as given in Meteorology for Mariners to forecast the weather at specific places
- evaluates the use of prognostic charts
- evaluates the information given in shipping forecasts

1.4 The Maritime Forecast Code and the Range of Information Available Through Fax Transmissions (2 hours) — R1, R2 Ch. V

- describes the purpose of the Maritime Forecast Code (Mafor)
- interprets the data given by Mafor
- lists the information available to the mariner in fax transmissions
- discusses the source of information relating to radio stations, and their transmissions
- evaluates the information given in surface synoptic and prognostic fax charts
- interprets the information given in wave charts
- evaluates the information given in the nephanalyses
- evaluates the information given in ice charts
- evaluates the use of 500 hPa charts in forecasting the progress of depressions
- evaluates the value of personal observations of weather signs, in evaluating weather trends

1.5 The Main Types of Floating Ice, Their Origins and Movements (2 hours) — R1

- explains the formation of icebergs from floating glacier tongues and from ice shelves, and the characteristics of each
- discusses the formation of sea ice
- defines ice tongue, ice shelf
- defines pack ice and fast ice
- discusses the normal seasons and probable tracks of North Atlantic bergs from origin to decay
- defines the outer limits of the area in which icebergs may be encountered in the North Atlantic

COMPETENCE 1.7	Forecast Weather and Oceanographic Conditions	IMO Reference

- discusses the normal and extreme limits of iceberg travel in the southern oceans during summer and winter
- explains the reasons for the decay of icebergs
- describes the areas affected by sea ice in regions frequented by shipping
- discusses the seasonal development and recession of sea ice on the coastlines of the northern oceans, and in the latitude of the normal trade routes

1.6 The Guiding Principles Relating to the Safety of Navigation in the vicinity of Ice (1 hour) — R1, R2 Ch. V

- states the signs which may indicate the proximity of ice on clear days and nights
- defines the ranges at which observers may expect to detect ice visually in varying conditions of visibility, see T61
- discusses the limitations of radar as a means of detecting ice
- states the precautions to be taken when navigating near ice, and when ice is suspected in the vicinity

1.7 Conditions Leading to Ice Accretion on Ship's Superstructures, Dangers and the Remedies Available (2 hours) — R1

- describes the factors which may give rise to ice accretion
- describes the use of data in the Mariner's Handbook, for estimating the rate of ice accretion
- evaluates the methods of avoiding or reducing ice accretion
- explains the reports to be made under International Conventions when ice is encountered
- lists the information to be given in radio messages reporting dangerous ice
- states the iceberg nomenclature in use by the International Ice Patrol
- lists the information to be given in radio messages reporting conditions leading to severe ice accretion on ship's superstructures

1.7.2 CHARACTERISTICS OF VARIOUS WEATHER SYSTEMS

Textbooks: T47, T48
Teaching aids: A1

Required performance:

2.1 The Formation, Structure and Weather Associated with The Principal Frontal Systems (2 hours) — R1

- describes a front and a frontal zone
- sketches the structure of a typical frontal zone

COMPETENCE 1.7	Forecast Weather and Oceanographic Conditions	IMO Reference

- explains qualitatively the process of frontogenesis
- explains qualitatively the process of frontolysis
- explains with the aid of a diagram, the structure of an idealized cold front
- explains the sequence of weather associated with the passage of an idealized cold front
- explains with the aid of diagrams, the formation of, and weather associated with a 'line squall'
- describes with the aid of diagrams, the structure of an idealized warm front
- describes the sequence of weather associated with the passage of an idealized warm front
- explains with the aid of diagrams, the orientation of isobars which cross a front
- describes with the aid of diagrams, the weather at the Inter Tropical Convergence Zone, both when it is close to, and more than 5° from, the equator

2.2 The Formation of, and Weather Associated with, Frontal and Non-Frontal Depressions (2 hours) R1

- explains qualitatively why the polar front is a favourable breeding ground for frontal depressions
- describes, with the aid of diagrams, the formation, development and decay of frontal depressions
- defines 'family of depressions'
- draws a typical synoptic pattern showing a family of frontal depressions and the associated pressure distribution
- explains qualitatively the process of the occlusion of a frontal depression
- describes with the aid of diagrams, the distribution of weather in a depression
- explains qualitatively the formation of frontal and non-frontal secondary depressions
- draws diagrams of frontal and non-frontal secondary depressions showing isobars and wind circulation
- describes the weather changes experienced during the passage of a secondary depression
- explains qualitatively, with the aid of diagrams, the formation of warm occlusions and cold occlusions
- draws cross sections through warm and cold occlusions showing temperature distribution, and cloud and precipitation areas
- describes the weather experienced during the passage of warm and cold occlusions with reference to objectives in the previous section
- compares alternative theories of cyclonic development since Bjerknes

COMPETENCE 1.7	Forecast Weather and Oceanographic Conditions	IMO Reference

2.3 The Formation and Weather Characteristics of Non-Frontal Weather Systems (2 hours) — R1

- defines 'trough of low pressure', both frontal and non-frontal
- draws a synoptic pattern of frontal and non-frontal troughs, for both northern and southern hemispheres, showing isobars, wind circulation and, if applicable, front
- identifies a trough of low pressure on a surface synoptic or prognostic chart
- explains the weather associated with the passage of a trough of low pressure
- defines an anticyclone
- draws a synoptic pattern of an anticyclone, for both northern and southern hemispheres, showing isobars and wind circulation
- identifies an anticyclone on a surface synoptic or prognostic chart
- describes the general characteristics of an anticyclone
- explains qualitatively the formation of warm and cold anticyclones
- applies previous concepts to an explanation of the weather associated with an anticyclone, in summer and winter
- defines ridge of high pressure
- draws a synoptic pattern of a ridge which is an extension of an anticyclone, showing isobars and wind circulation for northern and southern hemispheres
- draws a synoptic pattern of a ridge contained between two lows, showing isobars and wind circulation, for northern and southern hemispheres
- identifies a ridge of high pressure on a surface synoptic or prognostic chart
- explains the weather associated with both types of ridge of high pressure
- defines col
- draws a synoptic pattern of a col showing isobars and wind circulation
- explains the weather associated with a col
- draw synoptic patterns showing combination of various isobaric systems

2.4 Tropical Revolving Storms (TRS) (2 hours) — R1, R2

- states the definitions adopted by the WMO with respect to Tropical Storms
- states local nomenclature of TRS
- states regions and seasons of greatest frequency of TRS
- states the conditions associated with the formation of tropical revolving storms
- states the factors which affect the future movement of a TRS
- describes with the aid of diagrams typical and possible tracks of TRS
- explains the factors associated with the decay of TRS

COMPETENCE 1.7	Forecast Weather and Oceanographic Conditions	IMO Reference

- draws a plan of a TRS showing isobars, wind circulation, path, track, vortex or eye trough line, dangerous semicircle, dangerous quadrant and navigable semicircle (for north and south hemisphere)
- explains the reasons for the naming of the dangerous semicircle
- draws a cross section through a TRS showing areas of cloud and precipitation
- describes the characteristics of a TRS, ie size, wind, pressure, eye, cloud and precipitation sequence
- describes the signs which give warning of the approach for the TRS
- explains the methods of determining the approximate bearing of an approaching TRS
- explains the method of determining in which sector of a TRS the ship is situated
- states the correct avoidance procedure when in the vicinity of a TRS
- given the position and direction of travel of a TRS and ship's voyage information, describes appropriate measures to avoid the danger sector of a TRS
- describes the messages required to be sent in accordance with the requirements of SOLAS, when a TRS is encountered, or suspected to be in the vicinity
- describes the message required to be sent in accordance with the requirement of SOLAS when a wind of or above storm force 10 is encountered which has not previously been reported

1.7.3 OCEAN CURRENT SYSTEMS

Textbooks: T47, T48, T61
Teaching aids: A1, A12, A19

Required performance:

3.1 Surface Water Circulation of the Ocean and Principal Adjoining Seas (2 hours) — R1

- defines qualitatively the effect of geostrophic force on surface currents
- discusses the generation of drift currents by prevailing winds
- discusses the generation of gradient currents from differences in water temperature and salinity
- discusses the generation of gradient currents resulting from the indirect effect of wind causing a piling up of water on windward coasts as in the case of the Equatorial Counter Currents
- analyses the nature of currents formed by a combination of the above as experienced by western shores of large land masses
- relates the general pattern of surface water circulation to the atmospheric pressure distribution

COMPETENCE 1.7	Forecast Weather and Oceanographic Conditions	IMO Reference

- constructs a chart showing global surface water circulation applicable to the above
- describes the seasonal changes in the above in areas under the influence of the Asiatic monsoons
- identifies the principal individual currents by name
- analyses the causes of individual currents where explicitly stated in Meteorology for Mariners
- explains the classification of individual currents as warm or cold where appropriate
- describes the form in which surface current data is presented in current atlases and on routeing charts
- evaluates qualitatively the use of this data in passage planning
- explains the derivation of the current rose
- explains the derivation of the predominant current
- shows the meaning of the term constancy when applied to predominant currents
- explains the derivation of the vector mean current
- compares qualitatively the values of the information given by the current rose, the predominant current and the vector mean current as aids to passage planning

3.2 Voyage Planning Principles with Respect to Weather Conditions and Wave Height (2 hours) — R1, R2

- selects and uses data from Ocean Passages of the World
- describes climatological routeing
- defines significant wave height
- discusses the factors affecting wave height and direction
- describes the methods employed in forecasting wave heights
- describes optimum (least time) routeing
- evaluates the forms of routeing in the above objectives
- describes the methods of constructing a least time track
- appraises the relative merits of ship and shore based routeing, and their limitations
- describes the construction of ships performance curves
- demonstrates the use on monthly Routeing Charts
- explains the construction and use of a Baillie wind rose
- demonstrates familiarity with the forms of climatological, meteorological and current data presented in the Sailing Directions (Pilot Books) and in the Mariner' Handbook

3.3 The Formation of Sea Waves and Swell Waves (2 hours) — R1

- explains the role of wind in wave formation
- explains the importance of wind force in wave formation

COMPETENCE 1.7	Forecast Weather and Oceanographic Conditions	IMO Reference

- explains the importance of duration of wind causing waves
- explains the importance of fetch in the growth of waves
- uses Dorrenstein's nomogram for forecasting significant wave heights
- states the relationship between sea waves and swell waves
- explains the decay of swell waves as they travel from the area of origin

1.7.4 CALCULATION OF TIDAL CONDITIONS

Textbooks: T1
Teaching aids: A1

Required performance:

4.1 Apply the relevant weather conditions to tidal calculations (see also 1.2.1.4) (1 hour) — R1

- evaluates qualitatively the effect of high or low atmospheric pressure on tide levels
- evaluates qualitatively the effect of persistent winds on tide levels and tidal times
- evaluates qualitatively the effect of abrupt changes of weather conditions on tidal levels
- describes seismic waves, their origin and areas of prevalence

1.7.5 APPROPRIATE NAVIGATIONAL PUBLICATIONS ON TIDES AND CURRENTS

Textbooks: T1
Teaching aids: A1

Required performance:

5.1 Apply tide and current data from nautical publications and charts (2 hours) — R1

- uses tidal height calculations in passage planning, with regard to limiting draughts and times of available depth of water
- uses tidal stream information in passage planning, with regard to effect on course made good, and effect on speed, timing of events
- uses current information in passage planning, with regard to effect on course made good, and effect on speed, timing of events

COMPETENCE 1.8	Respond to Navigational Emergencies	IMO Reference

TRAINING OUTCOMES:

STCW Code
Table A-II/2

Demonstrates a knowledge and understanding of:

1.8.1 PRECAUTIONS WHEN BEACHING A SHIP

1.8.2 ACTION TO BE TAKEN IF GROUNDING IS IMMINENT AND AFTER GROUNDING

1.8.3 REFLOATING A GROUNDED SHIP WITH AND WITHOUT ASSISTANCE

1.8.4 ACTIONS FOR IMMINENT COLLISION, AFTER COLLISION AND IMPAIRMENT OF THE WATERTIGHT INTEGRITY OF THE HULL

1.8.5 ASSESSMENT OF DAMAGE CONTROL

1.8.6 EMERGENCY STEERING

1.8.7 EMERGENCY TOWING ARRANGEMENTS AND TOWING PROCEDURES

COMPETENCE 1.8	Respond to Navigational Emergencies	IMO Reference

1.8.1 PRECAUTIONS WHEN BEACHING A SHIP

Textbooks: T10
Teaching aids: A1

Required performance:

1.1 **Precautions When Beaching a Ship** (2 hours) — R1

- describes the circumstances in which a vessel may be beached
- states that a gently shelving beach of mud, sand or gravel should be chosen if possible
- states that beaching should be at slow speed
- states that, when trimmed heavily by the head, beaching stern first may be advantageous
- compares the relative advantages of beaching broadside-on and at right-angles to the beach
- states that wind or tide along the shore will quickly swing the ship broadside-on to the beach
- describes measures which can be taken to prevent the ship driving further ashore and to assist with subsequent refloating
- states that ballast should be added or transferred to counteract a tendency to bump on the bottom
- states that all tanks and compartments should be sounded and an assessment made of damage to the ship
- states that soundings should be taken to establish the depth of water round the ship and the nature of the bottom

1.8.2 ACTIONS TO BE TAKEN IF GROUNDING IS IMMINENT AND AFTER GROUNDING

Textbooks: T10
Teaching aids: A1

Required performance:

2.1 **Grounding** (2 hours) — R1, R2

- states that, on stranding, the engines should be stopped, watertight doors closed, the general alarm sounded and, if on a falling tide, the engines should be put full astern to see if the ship will immediately refloat
- states that the engineers should be warned to change to high-level water intakes
- states that a distress or urgency signal should be transmitted and survival craft prepared if necessary
- states that all tanks and compartments should be sounded and the ship should be inspected for damage

COMPETENCE 1.8	Respond to Navigational Emergencies	IMO Reference

- states that any discharge or probable discharge of harmful substances should be reported to the nearest coast radio station
- states that soundings should be taken to establish the depth of water round the ship and the nature of the bottom

1.8.3 REFLOATING A GROUNDED SHIP WITH AND WITHOUT ASSISTANCE

Textbooks: T10
Teaching aids: A1

Required performance:

3.1 Refloating (1 hour) — R1

- describes measures which can be taken to prevent further damage to the ship and to assist with subsequent refloating
- explains how ballast or other weights may be moved, taken on or discharged to assist refloating
- describes the use of ground tackle for hauling off
- describes ways in which tugs may be used to assist in refloating
- describes the use of the main engine in attempting to refloat and the danger of building up silt from its use

1.8.4 ACTION TO BE TAKEN IF COLLISION IS IMMINENT, AFTER A COLLISION OR IMPAIRMENT OF THE WATERTIGHT INTEGRITY OF THE HULL

Textbooks: T10
Teaching aids: A1

Required performance:

4.1 Collision (2 hours)

- lists the duties of the master following a collision — R1
- states that after impact the engines should be stopped, all watertight doors closed, the general alarm sounded and the crew informed of the situation — R2
- states that in calm weather the colliding ship should generally remain embedded to allow the other ship time to assess the damage or prepare to abandon ship
- states that survival craft should be made ready for abandoning ship or assisting the crew of the other ship
- states that a distress or urgency signal should be made, as appropriate
- states that requests for information may be received from coastal States
- states that, if not in danger, own ship should stand by to render assistance to the other for as long as necessary

COMPETENCE 1.8	Respond to Navigational Emergencies	IMO Reference

- states that any discharge or portable discharge of harmful substances should be reported to the nearest coast radio station R14
- states that the owners should be informed and all details of the collision and subsequent actions entered in the log-book R1

1.8.5 ASSESSMENT OF DAMAGE CONTROL

Textbooks: T10
Teaching aids: A1

Required performance:

5.1 **Assessment of Damage Control** (1 hour) R1

- states that damage to own ship should be determined
- describes measures to attempt to limit damage and salve own ship

1.8.6 EMERGENCY STEERING

Textbooks: T10
Teaching aids: A1

Required performance:

6.1 **Emergency Steering** (2 hours) R1

- describes typical arrangements of auxiliary steering gear
- describes how the auxiliary steering gear is brought into action
- describes how to change from bridge control to local control in the steering gear compartment
- states that, when appropriate, a disabled ship should report to a coastal State that it is a potential hazard to other ships or to the environment R14
- lists possible course of action which may be taken by a disabled ship
- describes methods of securing the rudder in the event of a broken rudder stock
- explains that, in the event of the loss of the rudder, jury steering may be achieved by providing a drag on either side of the ship
- describes a jury steering arrangement using materials normally found aboard ship
- describes a means of constructing a jury rudder, where practicable
- states the navigational safety message to broadcast and signals to be displayed by a disabled vessel

1.8.7 EMERGENCY TOWING ARRANGEMENTS AND TOWING PROCEDURES

Textbooks: T10
Teaching aids: A1

Required performance:

7.1 Emergency Towing Arrangements (2 hours) R1

- states that permission from the owners or charterers is usually required before towing, except for the purpose of saving life
- states that a coastal State may intervene when a disabled ship presents a potential risk to the environment
- states that early communication should be established between the vessels to agree on the method of connecting the tow
- states that both vessels should have everything prepared and have agreed on communication before the arrival of the towing ship
- describes how to approach a disabled vessel and pass the first connection by line-throwing apparatus or other methods
- states that the tow normally passes a messenger followed by a wire messenger to the towing vessel to haul across the towing line
- describes how to pay out the towing wire under control
- describes methods of securing the towing wire at the towing ship
- explains why the wire is usually shackled to the anchor cable of the tow
- describes the preparations made by the disabled ship
- states that the towing wire should be protected from chafing at fairleads
- states that wires and cables should be inspected frequently and the nip freshened if any sign of wear or chafe is found
- describes how to take the weight of the tow
- explains how the towing speed should be decided
- describes how to disconnect the tow on arrival at the destination
- describes the emerging towing arrangements for all tankers of not less than 20,000dwt SOLAS Ch II-1 Res. 35(63)

COMPETENCE 1.9	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

TRAINING OUTCOME:

Demonstrates a knowledge and understanding of:

STCW Code Table A-II/2

1.9.1 MANOEUVRING AND HANDLING A SHIP IN ALL CONDITIONS

COMPETENCE 1.9	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

1.9.1 MANOEUVRING AND HANDLING A SHIP IN ALL CONDITIONS

Textbooks: T2, T10, T16, T21, T38, T53
Teaching aids: A1, V4, V5, V6, V7, V8

Required performance:

1.1 Approaching A Pilot Vessel (4 hours) — R1

- explains how a passage plan from sea to berth is prepared
- states that the pilot station should be contacted about 2 hours before the expected arrival time — R2, R20, R21, R23
- describes the preparations for picking up a pilot — R2
- states that a second steering-gear power unit should be in operation where possible
- states that steering should be changed to manual in ample time and tested — R2
- states that anchors should be cleared and ready for letting go
- explains how to reduce speed when approaching the pilot station, taking account of wind and tidal set
- explains why the ship's speed should be reduced to a suitable speed for the pilot boat to come alongside
- describes how to make a lee for the pilot boat
- states that extra care should be taken after dropping the pilot until clear of inward ships manoeuvring to embark pilots — R1

1.2 Ship Handling in Restricted Waters (10 hours) — R1

- defines shallow water as a depth of less than 1.5 times the ship's draught
- explains that shallow-water effects become more marked as the underkeel clearance decreases
- lists shallow-water effects as:
  - increased directional stability and sluggish response to helm
  - the speed falls less during turns
  - a large increase in turning radius
  - a more pronounced effect from transverse propeller thrust
  - a possibility that transverse thrust may act in the opposite way expected
  - the ship carries her way longer and responds slowly to changes in engine speed
  - the trim changes, usually by the head for a full hull form
  - an increase in squat

COMPETENCE 1.9	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

- defines squat as the reduction of under-keel clearance resulting from bodily sinkage and change of trim which occurs when a ship moves through the water
- calculates the approximate sinkage due to squat in deep water
- states that the squat in shallow water (ratio of water depth/draught = 1.2) may be double that in deep water
- uses a squat estimation diagram
- explains the meaning of 'blockage factor' in restricted channels
- explains how squat and trim effects increase with blockage factor
- describes the reduction in keel clearance resulting from rolling and pitching and heel or list
- states that speed should be moderate in rivers, estuaries, etc. to reduce shallow-water effects and to provide reserve power for correcting a sheer
- describes how to round bends in a channel with a current in either direction, taking account of the effect of wind
- describes the use of an anchor to assist in rounding a bend
- describes how to turn short round in a narrow channel, with or without a wind
- describes the use of an anchor to assist turning in a channel
- explains the importance of navigating at reduced speed to avoid damage caused by own ship's bow wave or stern wave
- describes how a passing ship affects a moored ship

1.3 Constant Rate of Turn Techniques (1 hour) R1

- describes the circumstances in which a constant rate turn is appropriate
- describes how to plan a constant rate turn
- describes how to judge the correct execution of a constant rate turn by visual means
- describes how radar can be used to assist in monitoring a constant rate turn
- describes how to determine the wheel over position bearing for a constant rate turn R1
- describes how a constant rate turn is effective in helping a vessel maintain its planned trail

1.4 Manoeuvring in Shallow Water (2 hours) R1

- describes the use of the kick-ahead to control the speed and direction of the vessel
- explains how a ship will respond to helm before increasing speed when using a kick-ahead
- identifies the danger of taking a sheer in shallow water and what corrective action can be taken
- describes how tugs can be used to assist in maintaining slow speed control
- describes how anchors can be used to assist in manoeuvring a vessel in shallow water

COMPETENCE 1.9 Manoeuvre and Handle a Ship in all Conditions	IMO Reference

1.5 Interaction: Bank, Canal, Ship and Tug (2 hours) R1

- explains and describes the interaction between ship and shore
- explains and describes the interaction between ships when meeting end-on
- explains and describes the interaction between ships in an overtaking situation
- explains the particular dangers of interaction when working close by other craft such as tugs
- describes the pattern of pressure changes round the hull of a moving ship
- explains the interaction between a ship and nearby banks (bank cushion and bank suction)
- describes the interaction between passing ships
- describes how to pass or overtake another ship safely in a narrow channel
- explains that shoal patches may give rise to bank cushion or suction, resulting in an unexpected sheer

1.6 Berthing and Unberthing (12 hours) R1

- describes the effects of right- and left-handed propellers on manoeuvring
- describes the use of twin screws for manoeuvring
- explains the advantages and disadvantages of controllable-pitch propellers with regard to ship handling
- describes the use of lateral thrusters
- states that lateral thrusters cease to be effective above a certain speed, which has to be determined by trial
- describes, with reference to ship type and trim, the likely effect of wind on a ship when moving ahead or astern and when stopped
- explains how an anchor or anchors may be used to assist in manoeuvring
- describes the use of anchors for stopping in an emergency
- describes the different ways in which tugs may be made fast and used
- explains fully how to use engine, helm, tugs, anchors and mooring lines to berth and unberth under various conditions of wind and tide at:
  - river berths
  - piers
  - locks
  - enclosed docks
  - a single buoy
  - two buoys
  - multibuoy berths
  - Mediterranean moorings
- describes the mooring lines to be used, their leads and methods of securing at the berths listed above

COMPETENCE 1.9 Manoeuvre and Handle a Ship in all Conditions	IMO Reference

1.7 Use of Propulsion and Manoeuvring Systems (1 hour) R1

- describes how the use of bow-thrust can be used to assist in manoeuvring
- describes how the use of stern-thrust can be used to assist in manoeuvring
- describes the use of high-lift rudder systems to improve ship manoeuvrability
- describes the use of dynamically positioned vessels and their control systems
- describes the use of rudder cycling to reduce head reach in an emergency
- compares the effectiveness of rudder cycling with a crash stop

1.8 Anchoring (6 hours) R1

- explains how to choose an anchorage and lists the factors which influence the choice
- states that an anchoring plan should be prepared in advance, showing the direction and speed of approach and the dropping position(s), with check bearings
- describes the preparation of anchors, including walking the anchor back for anchoring in deep water
- explains how to judge that a ship is stopped ready for letting go
- explains that positions should be obtained on letting go and again when brought up
- describes the use of anchor buoys
- lists the factors to consider in determining the length of anchor cable to be used as:
  - the nature of the bottom
  - the strength of current or wind
  - the exposure of the anchorage to bad weather
  - the amount of room to swing
  - the expected length of stay at anchor
- defines dragging and explains how to detect it
- describes the actions to be taken when the anchor starts to drag
- explains how excessive yawing may break the anchor out of its holding and describes measures to control yaw
- describes how to bring a ship to an open moor
- explains what is meant by 'foul hawse' and how it occurs
- describes how to clear a foul hawse
- describes how to clear a fouled anchor
- describes how to buoy and slip an anchor

1.9 Dry-Docking (2 hours) R1

- lists the information required by the dry-dock authorities as:
  - length, beam and rise of floor, if any
  - draughts and trim
  - position of bilge keels and appendages such as a bulbous bow
  - whether single or twin screw
  - the weight and disposition of any cargo on board
  - position of any hull damage for inspection or repair

COMPETENCE 1.9	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

- states that a plan showing the position of bulkheads, main structural members and drain plugs is required for the preparation of beds and shores when dry-docking in the loaded condition
- explains why a slight trim by the stern is the ideal condition for dry-docking
- explains the need for adequate statical stability and states when the most critical condition occurs
- describes the use of bilge blocks, breast shores and bilge shores and their placement during pumping out
- states that all tanks should be sounded and the readings recorded when the ship takes the keel blocks
- explains why, as far as possible, tanks should be full or empty
- explains that tanks and movable weights should be restored to their original condition before flooding the dock to ensure the same trim and zero list on refloating
- explains why a ship may be left partially waterborne if damage is accessible
- explains how an adequate supply of water for fire fighting and a telephone for calling emergency services should be arranged
- lists the precautions to be taken and the preparations to be made before flooding the dock

1.10 Handling Ships in Heavy Weather (6 hours) — R1

- states that the use of weather routeing can reduce the number of occasions on which heavy weather is encountered
- describes the precautions to be taken before the onset of heavy weather
- defines wavelength, period and period of encounter of waves and swell
- defines rolling period and synchronous rolling
- explains how synchronous rolling can be avoided by an alteration of speed or course to change the period of encounter
- describes synchronous pitching and how to prevent it
- describes how excessive speed into head seas can cause severe panting and slamming stresses
- states that excessive slamming may be almost unnoticed on the bridge of a very large ship
- explains that heavy pitching also gives rise to high longitudinal stresses, racing of the propeller and the shipping of water
- defines 'pooping' and describes the conditions in which it may occur
- defines 'broaching-to' and describes the conditions in which it may occur
- explains that a reduction in speed combined with an alteration of course can reduce the danger of broaching-to and of being pooped
- describes how to turn a ship in heavy seas
- states that a ship may be hove-to with the wind on the bow or on the quarter or stopped

COMPETENCE 1.9 Manoeuvre and Handle a Ship in all Conditions **IMO Reference**

- describes the circumstances in which each of the methods above may be used
- describes methods of turning a disabled ship's head to keep it out of a sea trough and of lessening lee drift
- explains that a ship may drift at an angle to the downwind direction and that its direction of drift will depend upon which side it has the wind
- describes how to use oil to reduce breaking seas when hove-to and when manoeuvring in heavy seas
- describes actions to prevent a ship being driven on to a lee shore
- describes how to assist a ship or aircraft in distress
- describes towing operations
- explains the precautions to be taken in manoeuvring for launching boats or liferafts in bad weather
- describes the methods of taking on board survivors from lifeboats or liferafts

1.11 Rescue Boats and Survival Craft (2 hours) — Section A-VI/2

- explains how to make a lee for launching/recovering survival craft
- describes the effect of speed and the effect of flowlines around the vessel

1.12 Manoeuvring and Propulsion Characteristics (3 hours) — R1, R2 Ch. V Reg. 23, R18

- states that opportunity should be taken to check and supplement the information in the ship's manoeuvring booklet for intermediate draughts and for various weather conditions
- describes how to determine and plot the results of trial turning circles
- states that turning circles in shallow water at various manoeuvring speeds should be recorded when possible
- states that details of an accelerated turn in shallow water should be obtained
- explains how trials of stopping ability under various conditions should be recorded
- states that the effect of wind on the behaviour of the ship should be recorded, in particular:
  - the drifting behaviour when stopped
  - the speed at which steerage is lost in various conditions of loading and wind
  - the behaviour of the ship when making stern way
- states why the minimum operating revolutions of the engine and the resulting speed should be checked
- states that any details of manoeuvring behaviour which would be useful to a pilot or future master should be recorded
- states that STCW Code recommends additional training for masters and chief mates of large ships and ships with unusual manoeuvring characteristics — R1 Section B-V/a

1.13 Damage Due to Own Ship's Bow and Stern Waves (1 hour) — R1

- explains damage to shore due to excessive bow waves and stern waves
- explains the effects of passing ships on ships moored alongside

COMPETENCE 1.9 Manoeuvre and Handle a Ship in all Conditions **IMO Reference**

- states the precautions that should be taken by ships alongside to minimize the effect of passing traffic

1.14 Navigating in Or Near Ice (3 hours) R1, R9

- states that all possible information about ice located on or in the vicinity of the intended track should be obtained

- states that information is available from:
  - daily bulletins of the International Ice Patrol in the N. Atlantic
  - ice warnings from countries where ice is a regular problem
  - Hydrographic Office ice charts
  - pilot books
  - facsimile ice charts
  - warnings from other ships in the vicinity

- defines the following terms used in ice warnings:
  - solid ice
  - soft ice
  - drift ice
  - pack ice
  - growler
  - iceberg

- states the master's obligation to report dangerous ice or sub-freezing air temperatures associated with gale-force winds causing severe ice accretion on superstructures R2

- states that, when ice is reported on or near the course, the master of every ship is bound to proceed at a moderate speed or to alter course so as to go well clear of the danger zone

- explains that radar may not detect small icebergs and growlers

- states that navigation marks may be removed without warning in coastal areas threatened by ice

- states that no attempt should be made to enter a region of thick ice in a ship not specially strengthened for navigation in ice

- lists precautions to take when entering ice as:
  - estimating the thickness and concentration of ice and assessing whether the ship can safely pass through it
  - avoiding entry to pressure areas (shown by hummocks and rafting)
  - following leads used by previous ships, where possible
  - entering on the lee side of the ice, if practicable
  - entering at right angles to the ice edge, to avoid damage to hull, propeller and rudder
  - approaching at as slow a speed as possible, and increasing the power to maintain headway when the bow contacts the ice

- explains that leads through the ice show well on radar when set to short range

- explains precautions to be taken to avoid damaging the propeller and rudder when manoeuvring in ice

- explains how to obtain assistance from an ice-breaker

- states that it is important to follow the ice-breaker's instructions regarding speed and manoeuvring

- states that fenders should be ready for use when negotiating sharp turns in leads

- describes the precautions which should be taken to prevent freezing up of tail-end shafts, deck machinery and services

COMPETENCE 1.9	Manoeuvre and Handle a Ship in all Conditions	IMO Reference

- describes how to heave-to in an ice field
- describes the need to keep a look-out, when hove-to at night, for large ice drifting through the pack
- states that soft ice may block seawater intakes
- describes the conditions in which ice accumulates on decks and superstructures
- explains the dangers resulting from heavy accumulation of ice
- states that a change of course or speed should be made to reduce the shipping of freezing spray
- states that accumulated ice and snow should be cleared away as quickly as possible
- describes methods of clearing decks, rigging and superstructure of ice

1.15 Manoeuvring in TSS and VTS (2 hours) — R1, R2 Ch. V

- explains the requirements of the International Regulations for prevention of collisions at sea with respect to Traffic Separation Schemes and narrow channels
- discusses the actions that can be taken to manoeuvre the vessel in case of emergency
- describes the information that may be required by VTS officers before entering leaving or manoeuvring within a VTS controlled area

COMPETENCE 1.10	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

TRAINING OUTCOMES:

STCW Code Table A-II/2

Demonstrates a knowledge and understanding of:

1.10.1 OPERATING PRINCIPLES OF MARINE POWER PLANTS

1.10.2 SHIPS' AUXILIARY MACHINERY

1.10.3 GENERAL KNOWLEDGE OF MARINE ENGINEERING TERMS

COMPETENCE 1.10	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

1.10.1 OPERATING PRINCIPLES OF MARINE POWER PLANTS

Textbooks: T58
Teaching aids: A1

Required performance:

1.1 Marine Power Plants (34 hours) R1

Diesel Engines

- uses generally accepted engineering terms
- describes the 2-stroke diesel cycle
- describes the 4-stroke diesel cycle
- describes the advantages and disadvantages of a slow-speed diesel engine
- explains the cause of scavenge fires and how they are dealt with
- describes methods of supercharging
- describes the fuel oil system from bunker tank to injection
- describes the lubrication system
- describes engine cooling-water systems
- describes the advantages and disadvantages of a medium-speed diesel
- explains the need for gearing with medium-speed diesels
- describes the arrangement of clutch and gears
- describes how a diesel engine is prepared for stand-by
- describes the method of starting and reversing a diesel engine
- states that the number of starts is limited by the capacity of the starting air reservoir
- sets up, starts and stops a small diesel engine

Steam Turbine Systems

- describes the turbine, the feed system and the boiler as a system
- explains the working of an impulse turbine
- explains the working of a reaction turbine
- describes a steam turbine installation and its gearing
- distinguishes between and describes open and closed feed systems
- states that a steam turbine needs a large water-tube boiler
- describes the main features of a water-tube boiler
- describes in outline the procedure for raising steam

COMPETENCE 1.10 Operate Remote Controls of Propulsion Plant and Engineering Systems and Services **IMO Reference**

- lists the principal boiler mountings and explains their purpose
- describes the procedure for warming through a steam turbine ready for manoeuvring
- describes the procedures for manoeuvring when using a steam turbine

Propeller and Propeller Shaft

- describes the arrangement of thrust shaft, intermediate shafts and tailshaft
- explains how propeller thrust is transmitted to the hull
- describes how the propeller shaft is supported between the thrust block and the stern tube
- sketches and describes an oil-lubricated stern-tube bearing
- describes how the propeller is secured to the tailshaft
- sketches a propeller and indicates the following on it:
  - boss
  - cone
  - face
  - back
  - rake
  - skew
- defines pitch, slip and efficiency of a propeller
- calculates the percentage apparent slip from given data
- calculates the ship's speed, given the engine revolutions per minute, mean pitch and percentage slip
- describes the arrangement and operation of a controllable-pitch propeller (CPP)
- states the precautions to take with a CPP before:
  - starting the main engines
  - going to sea
  - entering harbour or confined waters
- states that changing control positions and the use of emergency hand control pitch and engine revolutions should be exercised

Bridge Control [1]

- describes a control system for the main engine, including control from bridge, machinery control room, engine control local and changeover controls
- describes bridge control of controllable-pitch propellers
- lists the indicators and alarms provided with bridge control
- describes the arrangement and operations of lateral thrusters
- describes the bridge control and indicators for lateral thrusters

1 Administrations may wish to provide specialized training in bridge control systems for personnel who are to serve on higher technology ships fitted with complex bridge control systems

COMPETENCE 1.10 Operate Remote Controls of Propulsion Plant and Engineering Systems and Services **IMO Reference**

1.10.2 SHIP'S AUXILIARY MACHINERY

Textbooks: T58
Teaching aids: A1

Required performance:

2.1 Ships' Auxiliary Machinery (36 hours) R1

- distinguishes between water-tube and fire-tube boilers
- describes auxiliary boilers
- describes a waste-heat boiler
- describes exhaust-gas heat exchangers
- describes steam-to-steam generators and explains where and why they are used
- describes a boiler fuel oil supply system
- describes the effect of dissolved salts in the feedwater and how it is treated
- explains what is meant by 'priming'
- states that carry-over of water may cause serious damage to turbine blading and to steam cylinders

Distillation and Fresh-water Systems

- describes a distillation system
- explains the operation of a flash evaporator
- describes the treatment of fresh water intended for drinking
- describes a domestic water system

Pumps and Pumping Systems

- classifies pumps as displacement, axial-flow or centrifugal
- describes the operation of a reciprocating pump
- describes rotary displacement pumps and states typical applications
- describes a screw pump and states possible uses
- describes an axial-flow pump and states possible applications
- describes a centrifugal pump and states typical applications
- explains the need to prime a centrifugal pump
- describes the head losses in a pumping system and how they are expressed
- explains net positive suction head and its significance in pump operation
- describes a typical bilge system and ballast system for a dry cargo vessel
- states that the engine-room emergency bilge suction is connected to the main circulating pump in the engine-room

COMPETENCE 1.10	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

Steering Gear

- describes ram-type hydraulic steering gear
- describes rotary-vane steering gear
- explains how hydraulic power is provided by variable-delivery pumps
- describes the IMO requirements for auxiliary steering gear and how they are met by ram-type and rotary-vane steering gear
- describes a telemotor control system
- describes electric steering control
- explains how the change from remote to local control in the steering-gear compartment is made
- describes the requirement for power supplies to electric and electrohydraulic steering gear
- describes the requirements for emergency control of the steering gear
- states the IMO requirements for testing steering gear and for drills

Generators, Alternators and Electrical Distribution

- describes the operation of a D.C. generator
- explains the functioning of shunt- and compound-wound D.C. motors
- describes the operation of an alternator
- explains the functioning of induction motors
- explains the relative advantages and disadvantages of generation and distribution of D.C. and A.C.
- describes D.C. and A.C. distribution systems
- describes the use of circuit-breakers and fuses
- describes and draws a navigation light circuit with indicators and alarm, showing an alternative power supply
- descries the use of rectifiers
- describes the characteristics of lead-acid batteries and of alkaline batteries
- describes the maintenance of batteries
- describes the safety precautions to be observed for battery compartments
- outlines the starting requirements for emergency generating sets
- lists the services to be supplied from the emergency generator
- describes the supplementary emergency lighting for ro-ro passenger ships

Refrigeration, Air-conditioning and Ventilation

- describes a vapour-compression-cycle refrigeration plant
- states desirable properties of a refrigerant

COMPETENCE 1.10	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

- states the properties of commonly used refrigerants
- describes the use of secondary refrigerants for cooling compartments
- explains the co-efficient of performance of a refrigeration plant
- describes an air-conditioning plant
- describes a ventilation system for accommodation
- describes a mechanical ventilation system for ships' holds

Stabilizers

- describes the construction and operation of fin stabilizers
- describes the arrangement and operation of a flume stabilizer

Sewage Treatment Plants — R9

- describes the operation of a chemical sewage treatment plant
- describes the operation of a biological sewage treatment plant

Oily-water Separators and Oil Filtering Equipment — R10

- describes the construction and operation of an oily-water separator (producing effluent that contains less than 100 ppm of oil)
- describes the construction and operation of oil filtering equipment (producing effluent that contains not more than 15 ppm of oil)
- explains why oily-water separators, even if well maintained and correctly operated, may not function properly
- describes how an oil-content meter functions
- describes an oil discharge monitoring and control system

Incinerators

- describes the functioning of a waste incinerator

Deck Machinery

- states that the design and performance of anchor windlasses is subject to approval by a classification society
- sketches and describes a windlass driving two de-clutchable cable lifters and warping drums
- explains the gearing necessary between the prime mover and cable lifters
- describes an arrangement that uses two mooring winches to drive windlass units
- states that both winches may be coupled mechanically to provide either a stand-by drive, in case one prime mover should fail, or the power of both prime movers on one windlass, if required
- describes the arrangement of vertical anchor capstans with driving machinery below deck
- describes a spooling device to distribute the wire evenly on the drum of a mooring winch

COMPETENCE 1.10	Operate Remote Controls of Propulsion Plant and Engineering Systems and Services	IMO Reference

- explains the working of self-tensioning winches
- briefly explains the advantages and disadvantages of steam, electric and hydraulic drive for mooring winches and capstans
- describes a cargo winch
- sketches and describes a slewing deck crane, its motors and its controls
- describes the lubrication of deck machinery

Hydraulic Systems

- states that a hydraulic system consists of an oil tank, pumps, control valves, hydraulic motors and pipework
- distinguishes between open- and closed-loop systems
- describes a live-line circuit supplied by a centralized hydraulic power system
- describes radial-piston and axial-piston variable-stroke pumps
- explains how the variable-stroke pump can act as controller and power supply
- sketches and describes a simple spool valve with shutoff and control of flow direction
- describes ram and rotary-vane actuators
- states that hydraulic systems can provide stepless control of speed for:
  - winches, cranes and other lifting devices
- describes a hydraulic accumulator and explains its purpose
- states that cooling of the hydraulic oil is necessary during operation to maintain the correct viscosity of the oil
- states that the oil may need to be heated before starting from cold
- states that cleanliness of the oil is essential for satisfactory operation and that all systems contain filters
- states that air in a system leads to erratic functioning

1.10.3 GENERAL KNOWLEDGE OF MARINE ENGINEERING TERMS

Textbooks: T58
Teaching aids: A1

Required performance:

3.1 Marine Engineering Terms and Fuel Consumption (4 hours) R1

- uses the correct engineering terms when describing and explaining the operation of the machinery and equipment mentioned above
- defines mass, force, work, power, energy, pressure, stress, strain and heat and states the units in which each is measured
- explains what is meant by the efficiency of machine
- describes an indicator diagram and the information obtainable from it

COMPETENCE 1.10 Operate Remote Controls of Propulsion Plant and Engineering Systems and Services **IMO Reference**

- defines indicated power, shaft power, propeller power and thrust
- defines the Admiralty coefficient (AC) as:

$$AC = \frac{(\text{displacement})^{2/3} \times (\text{speed})^3}{\text{engine power}}$$

- defines the fuel coefficient (FC) as:

$$FC = \frac{(\text{displacement})^{2/3} \times (\text{speed})^3}{\text{daily fuel consumption}}$$

- explains that for a given period of time:

$$\frac{\text{fuel consumption}^1}{\text{fuel consumption}^2} = \left[\frac{\text{displacement}^1}{\text{displacement}^2}\right]^{2/3} \times \left[\frac{\text{speed}^1}{\text{speed}^2}\right]^3$$

- explains that for a given distance:

$$\frac{\text{fuel consumption}^1}{\text{fuel consumption}^2} = \left[\frac{\text{displacement}^1}{\text{displacement}^2}\right]^{2/3} \times \left[\frac{\text{speed}^1}{\text{speed}^2}\right]^2$$

- explains that:

$$\frac{\text{voyage consumption}^1}{\text{voyage consumption}^2} =$$

$$\left[\frac{\text{displacement}^1}{\text{displacement}^2}\right]^{2/3} \times \left[\frac{\text{speed}^1}{\text{speed}^2}\right]^2 \times \frac{\text{voyage distance}^1}{\text{voyage distance}^2}$$

- given data from the previous performance, calculates:
  - the daily consumption at service speed
  - the bunker fuel required for a voyage
  - the speed for a given daily consumption
  - the reduced speed required to complete a voyage with a given consumption
- explains that, for fuel economy, the actual speed at any stage of a voyage should be as near as practicable to the required average speed
- explains how the condition of the hull affects the fuel coefficient and the fuel consumption
- explains that keeping the leading edges and tips of propeller blades dressed and polished improves propeller efficiency and reduces fuel consumption

Master and Chief Mate

Function 2:

Cargo Handling and Stowage at the Management Level

Master and Chief Mate
Function 2: Cargo Handling and Stowage at the Management Level

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Function 2 – Cargo Handling and Stowage at the Management Level

Part A2: Course Framework

Aims
This model course aims to meet the mandatory minimum requirements for knowledge, understanding and proficiency in Table A-II/2 of STCW 1995 for the function Cargo Handling and Stowage at the Management Level.

Objective
This syllabus covers the requirements of the 1995 STCW Convention Chapter II, Section A-II/2. This functional element provides the detailed knowledge to support the training outcomes related to Cargo Handling and Stowage at the Management Level.

This section provides the background knowledge to support the tasks, duties and responsibilities in:

- planning, safe loading, stowage, securing and care during the voyage and unloading of cargoes
- the carriage of dangerous goods.

This includes topics such as ship trim, stability, ballasting, cargo securing, tankers and tanker operations and carriage of dangerous, hazardous and harmful cargoes.

Entry standards
Entrants should have successfully completed a course covering the minimum standards required for certification as officer in charge of a navigational watch on ships of 500 gross tonnage or more (see IMO Model Course No. 7.03, Officer in Charge of a Navigational Watch). In addition they should have completed approved seagoing service as officer in charge of a avigational watch in accordance with STCW 1995 regulation II/2, paragraph 2.

Course certificate
On successful completion of the course and assessments, a document may be issued certifying that the holder has successfully completed a course of training which meets or exceeds the level of knowledge and competence specified in Table A-II/2 of STCW 1995, for the function Cargo Handling and Stowage at the Management Level.

A certificate may be issued only by centres approved by the Administration.

Staff requirements
Instructors shall be qualified in the task for which training is being conducted and have appropriate training in instructional techniques and training methods (STCW Code Section A-I/6). Depending on the complexity of the exercises set, an assistant instructor with similar experience is desirable for certain practical exercises.

Teaching facilities and equipment

A classroom equipped with an overhead projector and a blackboard or flipchart should be provided for teaching the theory of the course and holding group discussions.

The following equipment is recommended:

- a collection of photographs, drawings and plans, illustrating various types of ship and constructional details, should be provided
- a floating ship stability demonstration model and a flotation tank are recommended. The model should be capable of demonstrating the effects of adding or removing masses, of shifting masses, of suspending masses and of free surface liquid
- working models of heavy-lift derricks
- a ship's loading instrument or manufacturers' descriptions of examples of them
- capacity plans and hydrostatic data for one or more ships
- electronic calculators.

Teaching aids (A)

A1 Instructor Guidance (Part B of this course)
A2 Video cassette player

Video cassettes

V1 Preparing the defence (IMO Code No. VID-301)

Available from: IMO Publications Section
4 Albert Embankment
London SE1 7SR, UK
Fax: 44 171 587 3241
URL: www.imo.org

V2 Dangerous goods at sea series (Catalogue Code No. 387/8)
V3 Operation and maintenance of hatch covers (Catalogue Code No. 506)
V4 Bulk carrier losses (Catalogue Code No. 532)
V5 Ro-ro safety and cargo operations (Catalogue Code No. 162)
V6 Introduction to chemical tankers (Catalogue Code No. 100)
V7 Introduction to liquefied gas carriers (Catalogue Code No. 103)
V8 Cargo loss prevention on bulk carriers (Catalogue Code No. 598)

Available from: Videotel Marine International Ltd
84 Newman Street, London W1P 3LD, UK
Tel : 44 171 299 1800
Fax: 44 171 299 1818
e-mail: mail@videotelmail.com
URL: www.videotel.co.uk

IMO references (R)

R1 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1998 (IMO Sales No. 938), and 1997 Amendments to STCW 95 (IMO Sales No. 945)
R2 International Convention for the Safety of Life at Sea, 1974, as amended (SOLAS) (IMO Sales No. 110)
R3 International Convention for the Safety of Life at Sea, Texts and amendments relating to passenger ro-ro ferries adopted on 21 April and 28 October 1988, other amendments adopted on 11 April 1989 (IMO Sales No. 115)
R4 International Conference on Load Lines, 1966 (IMO Sales No. 701)
R5 Supplement relating to the International Convention on Load Lines, 1966 (IMO Sales No. 705)
R6 Code on Intact Stability for all types of ships covered by IMO instruments (IMO Sales No. 874)
R7 International Maritime Dangerous Goods Code (IMDG Code), 1994 (IMO Sales No. 200)
R8 Wall Chart: IMO dangerous goods labels, marks and signs (1994 edition) (IMO Sales No. 223)
R9 Medical First Aid Guide for Use in Accidents involving Dangerous Goods (MFAG) (IMO Sales No. 251)
R10 Emergency Procedures for Ships Carrying Dangerous Goods (EmS) (1994 edition) (IMO Sales No. 254)
R11 Code of Safe Practice for Solid Bulk Cargoes (BC Code) (1994 edition) (IMO Sales No. 260)
R12 Code of Safe Practice for Ships Carrying Timber Deck Cargoes (1991 edition) (IMO Sales No. 275)
R13 Recommendations on the Safe Transport, Handling and Storage of Dangerous Substances in Port Areas (1995 edition) (IMO Sales No. 290)
R14 Recommendations on the Safe Use of Pesticides in Ships (IMO Sales No. 267)
R15 Manual on Oil Pollution, Section 1, Prevention (Out of Print 1998)
R16 Assembly resolution A.288(VIII) – Recommendation on the safe stowage and securing of containers on deck on vessels which are not specifically designed and fitted for the purpose of carrying containers
R17 Assembly resolution A.489(XII) – Safe stowage and securing of cargo units and other entities in ships other than cellular container ships
R18 Assembly resolution A.533 13) – Elements to be taken into account when considering the safe stowage and securing of cargo units and vehicles in ships
R19 Assembly resolution A.581(14) – Guidelines for securing arrangements for the transport of road vehicles on ro-ro ships
R20 ILO Code of Practice, Accident prevention on board ship at sea and in port (Geneva, ILO office, 1978) (ISBN 92-2-101837-7)
R21 ILO Code of Practice, Safety and health in dock work, 2nd ed. (Geneva, ILO office, 1984) (ISBN 92-2-101593-9)
R22 ILO Convention No. 152, Occupational Safety and Health (Dock Work) Convention
R23 1994/95 amendments to the Code of safe practice for cargo stowage and securing (IMO Sales No. 295)
R24 Annex to MSC/Circ.385 – Provisions to be included in the Cargo Securing Manual to be carried on board ships
R25 International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) (1994 edition) (IMO Sales No. 100)
R26 International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) (IMO Sales No. 104)

R27 Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk – Annex II, MARPOL 73/78 (in IMO Sales No.520)

R28 International Convention for the Prevention of Pollution from Ships, 1973/78 (MARPOL) (IMO Sales No. 520)

R29 Code on intact stability for all types of ships covered by IMO instruments (1995 edition) (IMO Sales No. 874)

Details of distributors of IMO publications that maintain a permanent stock of all IMO publications may be found on the IMO web site at http://www.imo.org

Textbooks (T)

T11 Derrett, D.R Ship Stability for Masters and Mates, 4th ed. Butterworth-Heinemann,, 1984 (ISBN 0-7506-0380-1)

T31 International Safety Guide for Oil Tankers and Terminals. 4th ed. ICS/OCIMF. London, Witherby & Co. Ltd 1996 (ISBN 1-85609-081-7)

T32 Immer, J.R. Cargo Handling. Marine Education Textbooks, 1984 (ISBN 1-877977-806-8)

T41 Morton, G.S. Tanker Operations. A Handbook For The Ships Officer 3rd ed., 1992 (ISBN 0-87033-432-8)

T44 McGuire and White. Liquefied Gas Handling Principles on Ships and Terminals. 2nd ed. London, Witherby. 1996 (ISBN 1-8560-9087-6)

T63 Thomas, O.O., Agnew, J. and Cole, K.L. Thomas' Stowage : The Properties and Stowage of Cargoes, 3rd ed. Glasgow, Brown, Son & Ferguson, 1996

T68 Guidelines for the Inspection and Maintenance of Double Hull Tanker Structures. OCIMF. London, Witherby. 1995 (ISBN 1-8560-9090-9)

T69 Bulk Carriers: Guidance and information on bulk cargo loading and discharging to reduce the likelihood of overstressing the hull structures. IACS. London 1997

Function 2: Cargo Handling and Stowage at the Management Level

Part B2: Course Outline and Guidance Notes

Timetable

No formal example of a timetable is included in this model course.

Development of a detailed timetable depends on the level of skills of the trainees entering the course and the amount of revision work of basic principles that may be required.

Lecturers must develop their own timetable depending on:

- the level of skills of trainees
- the numbers to be trained
- the number of instructors

and normal practices at the training establishment.

Preparation and planning constitute an important factor which makes a major contribution to the effective presentation of any course of instruction.

Lectures

As far as possible, lectures should be presented within a familiar context and should make use of practical examples. They should be well illustrated with diagrams, photographs and charts where appropriate, and be related to matter learned during seagoing time.

An effective manner of presentation is to develop a technique of giving information and then reinforcing it. For example, first tell the trainees briefly what you are going to present to them; then cover the topic in detail; and, finally, summarize what you have told them. The use of an overhead projector and the distribution of copies of the transparencies as trainees handouts contribute to the learning process.

Course Outline

The tables that follow list the 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.

COURSE OUTLINE

Knowledge, understanding and proficiency	Total hours for each topic	Total hours for each subject area of Required performance
Competence		
2.1 PLAN AND ENSURE SAFE LOADING, STOWAGE, SECURING, CARE DURING VOYAGE AND UNLOADING OF CARGOES		
2.1.1 APPLICATION OF INTERNATIONAL REGULATIONS, CODES AND STANDARDS CONCERNING THE SAFE HANDLING, STOWAGE, SECURING AND TRANSPORT OF CARGOES		
.1 Plans and actions conform with international regulations	6	6
2.1.2 EFFECT ON TRIM AND STABILITY OF CARGOES AND CARGO OPERATIONS		
.1 Draft, trim and stability	20	20
2.1.3 STABILITY AND TRIM DIAGRAMS AND STRESS-CALCULATING EQUIPMENT		
.1 Shear forces, bending moments and torsional moments	8	
.2 Compliance with minimum freeboard requirements of the Loadline regulations	6	
.3 The use of vector diagrams to calculate stresses on cargo gear	6	
.4 Use of ADB equipment	2	22
2.1.4 STOWAGE AND SECURING OF CARGOES ON BOARD SHIP, CARGO-HANDLING GEAR AND SECURING AND LASHING EQUIPMENT		
.1 Timber deck cargoes	3	
.2 Procedures for receiving, tallying and delivering cargo	3	
.3 Care of cargo during carriage	4	
.4 Requirements applicable to cargo-handling gear	4	
.5 Maintenance of cargo gear	3	
.6 Maintenance of hatch covers	2	19
2.1.5 LOADING AND UNLOADING OPERATIONS, WITH SPECIAL REGARD TO THE TRANSPORT OF CARGOES IDENTIFIED IN THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING		
.1 Loading, stowage and discharge of heavy weights	3	
.2 Care of cargo during carriage	1	
.3 Methods and safeguards when fumigating holds	2	6
2.1.6 GENERAL KNOWLEDGE OF TANKERS AND TANKER OPERATIONS		
.1 Terms and definitions	1	
.2 Contents and application of ISGOTT	2	
.3 Oil tanker operations and related pollution-prevention regulations	3	
.4 Chemical tankers	3	
.5 Tank cleaning & control of pollution in chemical tankers	2	
.6 Gas tankers	3	
.7 Cargo operations in gas tankers	2	16

Teaching staff should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff available for teaching.

Knowledge, understanding and proficiency		Total hours for each topic	Total hours for each subject area of Required performance
2.2	**CARRIAGE OF DANGEROUS CARGOES**		
2.2.1	INTERNATIONAL REGULATIONS, STANDARDS, CODES AND RECOMMENDATIONS ON CARRIAGE OF DANGEROUS CARGOES		
	.1 International regulations and codes	2	2
2.2.2	CARRIAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES		
	.1 Dangerous goods in packages	10	
	.2 Solid bulk cargoes	9	
	.3 The IMO Grain Rules	7	26

Total for Function 2: Cargo Handling and Stowage at the Management Level 117

Teaching staff should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff available for teaching.

Guidance Notes

The following notes are intended to highlight the main objectives or training outcomes of each part of the function. The notes also contain some material on topics which are not adequately covered in the quoted references.

On completion of training for this function, officers will be able to use cargo plans and tables or diagrams of stability and trim data to calculate the ship's initial stability, draughts and trim for any given description of cargo and other weights. They will also be able to determine whether stresses on the ship are within permitted limits by the use of stress data or calculation equipment, or software.

Officers will be able to plan and supervise the stowage of cargo, taking account of all relevant regulations and safety codes. They will also be able to make the necessary calculations to ensure adequate stability and to check that shear forces and bending moments are within permitted limits.

The safety precautions before entering enclosed or potentially contaminated spaces will be understood and applied.

Officers will be able to supervise the preparation and dunnaging of holds and the operation of ships' cargo gear and will be aware of the importance of adequately securing cargo to prevent damage to the ship of cargo. They will identify dangerous goods and use the IMDG Code (R7) to ensure such cargoes are stowed and separated correctly. They will know the hazards related to some bulk cargoes and the precautions to take during their loading, carriage and discharge. They will also have a basic knowledge of the piping and pumping arrangements of oil tankers.

Function 2: Cargo Handling and Stowage at the Management Level

2.1 Plan and Ensure Safe Loading, Stowage, Securing, Care During The Voyage and Unloading of Cargoes

2.1.1 APPLICATION OF INTERNATIONAL REGULATIONS, CODES AND STANDARDS CONCERNING SAFE HANDLING, STOWAGE, SECURING AND TRANSPORT OF CARGOES

Instructors should refer to the many IMO references concerning this topic and design exercises to let officers practice using information contained in the Code of Safe Practice for Cargo Stowage and Securing and in a typical cargo securing manual.

2.1.2 EFFECT ON TRIM AND STABILITY OF CARGOES AND CARGO OPERATIONS

The time allotted to cargo calculations is based on the assumption that trainees have covered the necessary theoretical work in ship stability and strength to enable them to make calculations based on ship's data.

When calculating draughts and trim, solutions are simplified, especially when using calculators or computers, by the consistent use of signs. The convention signs used are:

loading	+	discharging	–
by the head	+	by the stern	–
forward of	+	abaft	–
starboard	+	port	–
hogging	+	sagging	–

If a loading instrument is available, trainees should be given the opportunity to use it to familiarize themselves with the type of input required and the output provided by it. Manufacturers' illustrations and descriptions can be used in addition to or in place of the instrument if trainees do not have access to one.

It has been assumed that trainees will already have some experience in using vector diagrams and that the exercises in finding stresses on cargo gear will be applications of that knowledge. Alternatively, that of the syllabus could be taught as part of the training in the use of vector diagrams.

2.1.3 STABILITY AND TRIM DIAGRAMS AND STRESS-CALCULATING EQUIPMENT

Shear force, bending moments and torsional moments

The load curve is given by the difference between the weight and buoyancy curves. Conventions on the sign of the load and hence on which side of the axis to plot the value vary between authors. The convention chosen is not important, but it is recommended that the chosen one is used consistently to avoid confusing trainees.

During the instruction the following properties of the curves should be pointed out to trainees:

- the total area under the weight curve equals the total area under the buoyancy curve;
- the area under the load curve above the axis equals the area below the axis;
- the maximum values of shear force occur where the load curve crosses the axis;
- the maximum values of bending moment occur where the shear-force curve crosses the axis; and
- the shear force and bending moment are zero at each end.

The classification society requirement for the carriage of a loading instrument for calculating shear forces and bending moments is commonly satisfied by the provision of a personal computer with approved programs on discs. In addition to calculating shear forces and bending moment, programs normally include the calculation of transverse stability, draught and trim. Other facilities to assist with cargo planning are also provided.

The program is arranged to perform a self-check on starting up, with a warning being given to the user if data corruption has occurred. A new copy of the master disc can be made and run to rectify that fault. If a printer is connected, a hard copy of results can be obtained.

Torsion

Torsional stresses tend to produce twisting of the ship's hull about the longitudinal centreline. All ships experience torsional stresses when subject to oblique sea waves. At a particular instant, the sea may be attempting to roll the forward end to starboard while the after end is trying to roll to port. The ship's structure is designed to withstand this wave-induced torsion.

For most ships, normal cargo operations do not induce torsional stresses but in container ships it is possible that an excess of weight to one side at one bay is balanced by an excess to the other side at another bay, thus setting up a torsional stress.

Because of their very large hatch openings, container ships are particularly liable to structural damage, such as cracking at hatch corners, resulting from torsional stress. The classification societies state maximum permissible cargo torsion values. They also recommend that uneven transverse distributions of weights should be avoided and that excess torsion should be monitored for each load condition by means of calculation sheets and graphical representation. If the torsional moments exceed the permissible level, water ballast can be added at appropriate positions to reduce them.

An example of part of a calculation sheet is shown in Figure 1 (page 104).

The levers for each row are printed on the sheet, the weights are entered and the products are calculated. The resulting moment for each bay is found and recorded, with the correct sign.

An example of loading is shown in Figure 2 (below).

The accumulated moment for each group of bays is plotted on a graph, as Figure 3 (page 105).

Example of loading

	1	2	3	4
Twin Bays	Torsion moment	Accumulated moments	Torsion moment	Accumulated moments
01/03	+150	+150	+150	+150
05/07	-200	-50	-200	-50
09/11	-1000	-1050	-1000	-1050
13/15	-100	-1150	-100	-1150
17/19	+50	-1100	+50	-1100
21/23	-600	-1700	+850	-250
25/27	-200	-1900	-200	-450
29/31	-300	-2200	-300	-750
33/35	+800	-1400	+800	+50
37/39	-50	-1450	-50	0

Column 2 shows a total listing moment of 1450 metre-tonnes to starboard and an excessive torsional moment at bays 25 to 31.

Water ballast is added or the anti-heeling tanks are adjusted to reduce the listing moment to zero and at the same time to reduce the excessive torsional moment. In this case, a moment of 1450 metre-tonnes to port has been introduced at bays 21/23.

Columns 1 and 2 are amended to take account of the ballast and are shown as columns 3 and 4. The graph is then re-drawn.

Figure 2

SHIP'S NAME: ____________ VOYAGE: ______ PORT: ______

TORSION A

FOR CARGO LOADED IN THIS PORT – EXPORTS ONLY

BAY	ON DECK ROW	12	10	08	06	04	02	00	01	03	05	07	09	11	EXPORTS: Loaded This Port +P -S	Loaded Prev. Port +P -S	Total on Departure +P -S	ACCUM. +P -S
01	D			9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x						
	U.D.			9.71 x	7.04 x	4.01 x	1.34 x		1.34 x	4.01 x	7.04 x	9.71 x						
02	D			9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x						
03	D			9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x						
	U.D.			9.71 x	7.04 x	4.01 x	1.34 x		1.34 x	4.01 x	7.04 x	9.71 x						
														SUB TOTAL				
05	D		12.31 x	9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x	12.31 x					
	U.D.		12.38 x	9.71 x	7.04 x	4.01 x	1.34 x		1.34 x	4.01 x	7.04 x	9.71 x	12.38 x					
06	D		12.31 x	9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x	12.31 x					
07	D	14.77 x	12.31 x	9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x	12.31 x	14.77 x				
	U.D.		12.38 x	9.71 x	7.04 x	4.01 x	1.34 x		1.34 x	4.01 x	7.04 x	9.71 x	12.38 x					
														SUB TOTAL				
09	D	14.77 x	12.31 x	9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x	12.31 x	14.77 x				
10	D	14.77 x	12.31 x	9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x	12.31 x	14.77 x				
	U.D.		12.38 x	9.71 x	7.04 x	4.01 x	1.34 x		1.34 x	4.01 x	7.04 x	9.71 x	12.38 x					
11	D	14.77 x	12.31 x	9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x	12.31 x	14.77 x				
														SUB TOTAL				
13	D	14.77 x	12.31 x	9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x	12.31 x	14.77 x				
	U.D.		12.38 x	9.71 x	7.04 x	4.01 x	1.34 x		1.34 x	4.01 x	7.04 x	9.71 x	12.38 x					
14	D	14.77 x	12.31 x	9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x	12.31 x	14.77 x				
15	D	14.77 x	12.31 x	9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x	12.31 x	14.77 x				
	U.D.		12.38 x	9.71 x	7.04 x	4.01 x	1.34 x		1.34 x	4.01 x	7.04 x	9.71 x	12.38 x					
														SUB TOTAL				
17	D	14.77 x	12.31 x	9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x	12.31 x	14.77 x				
	U.D.		12.38 x	9.71 x	7.04 x	4.01 x	1.34 x		1.34 x	4.01 x	7.04 x	9.71 x	12.38 x					
18	D	14.77 x	12.31 x	9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x	12.31 x	14.77 x				
19	D	14.77 x	12.31 x	9.85 x	7.39 x	4.92 x	2.46 x		2.46 x	4.92 x	7.39 x	9.85 x	12.31 x	14.77 x				
	U.D.		12.38 x	9.71 x	7.04 x	4.01 x	1.34 x		1.34 x	4.01 x	7.04 x	9.71 x	12.38 x					
BAY	U.D. ROW		10	08	06	04	02		01	03	05	07	09	SUB TOTAL				
															TOTAL TO CARRY FWD TORSION			

Figure 1

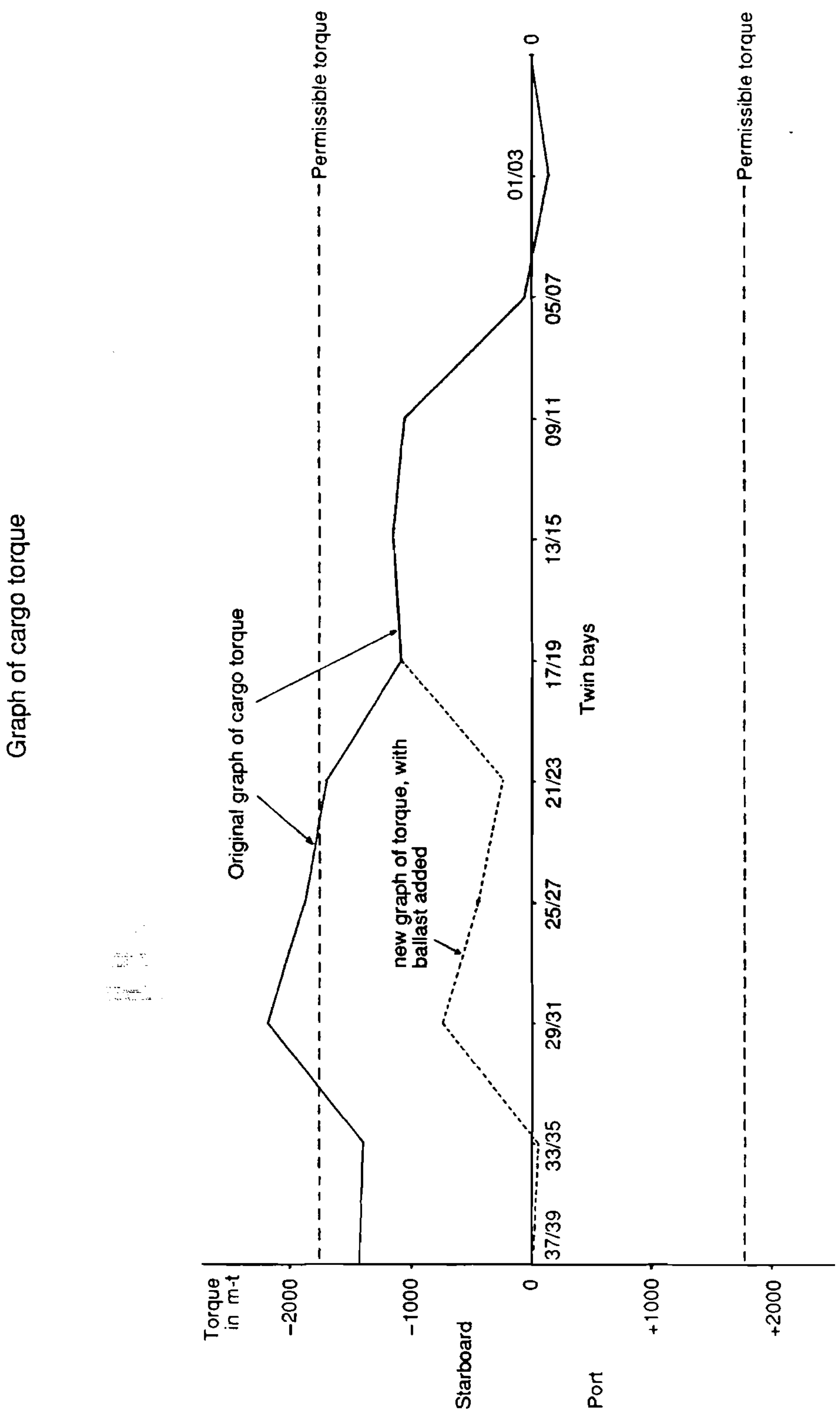
Graph of cargo torque
Torque in m-t
−2000
−1000
0
+1000
+2000
Starboard
Port
Permissible torque
Permissible torque
Original graph of cargo torque
new graph of torque, with ballast added
37/39
33/35
29/31
25/27
21/23
17/19
13/15
09/11
05/07
01/03
0
Twin bays

Figure 3

2.1.4 STOWAGE AND SECURING OF CARGOES ON BOARD SHIP, CARGO-HANDLING GEAR AND SECURING AND LASHING EQUIPMENT

Timber deck cargoes

The Code of Safe Practice for Ships carrying Timber Deck Cargoes (R9) should be fully covered. The emergency actions of the master for dealing with incidents such as the partial loss of the deck load or problems with stability resulting from water absorption or ice accretion should be included.

Procedures for receiving, tallying and delivering cargo

Tallying is normally undertaken by tally clerks, who are appointed by the ship or by the ship's agents. The cargo interests, shipper or consignee, will often also employ their own clerks. The two tallies should be compared at intervals and on completion of each consignment and an effort should be made to reconcile any discrepancy between them. When "specials, high-value cargo, mail and similar cargo is handled, it is usual for a ship's officer to keep a separate tally and to supervise the transfer into or out of lockers.

Trainees should realize that bills of lading are negotiable documents and provide title to ownership of the goods described in them. A cargo may be bought and sold on the evidence of the bill of lading and it is therefore essential that it provides a true and accurate description of the goods. Any damage or evidence of poor condition should be noted on the mate's receipts from which the bills of lading will be drawn up. The acceptance of letters of indemnity in return for clean bills for goods which are not in apparent good condition could be construed as compounding a fraud. When bills of lading contain descriptions which cannot be verified by the ship's officers, e.g. the quality of wheat in a grain cargo, they should be qualified by the inclusion of "said to be ....", "contents unknown, said to contain .." and similar expressions.

Where boat notes are signed as mate's receipts, care should be taken not to sign a duplicate note for the same consignment. That could lead to eventual claims for the complete loss of the consignment.

Containers are frequently shipped on through bills of lading which have been issued prior to their arrival at the ship. A check should be made that seals and locks are in place at shipment.

Trainees should be reminded that empty bags or other packages found during discharging should be landed and a receipt obtained for them to ensure that the freight earned on their carriage is obtained. Sweepings should be collected separately, put into bags and discharged as such, V8.

Care of cargo during carriage

The general principles of stowage and care of cargoes should be covered. The requirements for particular commodities can be found in reference books such as T63.

Measures taken for the care of cargo during the voyage, such as the use of ventilation systems or inspections of lashings, should be entered in the log-book. Entries should also be made if ventilation is suspended due to heavy weather or any other circumstances which may have an adverse effect on the cargo. The master will include such entries in the log extracts to support the noting of protest.

Requirements applicable to cargo-handling gear

Where a national register and certificates are applicable, trainees should be made familiar with the requirements of those and the details of tests and examinations which should be entered.

In some ports, the trades union representative of the dock labour force may insist on sighting the register and rigging plan before work commences. It is important that changes in items such as blocks and shackles attached to a derrick are noted on the rigging plan.

Maintenance of cargo gear

This section deals with the practical maintenance and inspection of cargo gear. Attention should be drawn to the requirement that no new item of loose gear should be made of wrought iron. Any existing items of wrought iron are subject to the requirements for periodic heat treatment, unless exempted.

Maintenance of hatch covers

The water tightness of hatch covers is vital, both for the safety of the ship and for the protection of cargo from water damage. Before loading a bulk cargo that has a tendency to liquefy or which produces dangerous fumes in contact with water, the hatch covers should be hose-tested for water tightness, (V3).

In combination carriers, the proper sealing of hatches is essential to prevent the release of flammable vapour at deck level and for the maintenance of a small positive pressure by the inert gas system.

2.1.5 LOADING AND UNLOADING OPERATIONS, WITH REGARD TO THE TRANSPORT OF CARGOES IDENTIFIED IN THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING

Loading, stowage and discharge of heavy weights

Heavy lifts require careful planning before loading. The position in which they are to be stowed must be prepared to accept the lift, possibly requiring the construction of special cradles to support the load. Adequate means of securing must be provided, which often necessitates the welding of additional eye-bolts to the deck. The stability of the ship must be sufficient to limit the list to a reasonable angle both when loading and discharging with the ship's gear. All heavy-lift operations should be supervised by a senior officer, (V5).

Methods and safeguards when fumigating holds

A thorough knowledge and understanding of the Recommendations on the Safe Use of Pesticides in Ships and its supplement is required.

2.1.6 GENERAL KNOWLEDGE OF TANKERS AND TANKER OPERATIONS

Terms and definitions

Instructors will find much of the material for the basis of lectures in T31.

Contents and application of the International Safety Guide for Oil Tankers and Terminals (ISGOTT)

This section is intended to provide a general introduction to tanker operations and the guidance available in the ISGOTT.

Oil tanker operations and related pollution-prevention regulations

Trainees should be aware of the procedures for ballasting, tank cleaning and gas-freeing and how these are performed within the requirements of MARPOL. A detailed treatment of the operations is not required, (V1).

Chemical tankers

This section provides a general introduction to the construction and equipment of chemical tankers as set out in the IBC Code. Only a simple treatment of operations is intended since officers who will serve in such ships are required to undertake additional specialized training. Further information on cargoes and operations may be found in reference Textbook Ref.T26 and video V6.

Tank cleaning and control of pollution in chemical tankers
The emphasis should be on how tank-cleaning and ballasting operations are carried out in compliance with Annex II of the MARPOL Convention and, in particular, on the use of the Procedures and Arrangements Manual to ensure compliance with the regulations.

Gas tankers
This section provides a general overview of the different types of gas tanker, their construction and their equipment as set out in the IGC Code. The treatment should take account of the fact that officers who will serve in gas tankers will undertake further specialized training, (V7).

Cargo operations in gas tankers
The objective of this section is to provide a general insight into the sequence of cargo operations carried out aboard gas tankers without going into detail. Further information will be found in references.

2.2 Carriage of Dangerous Cargoes

2.2.1 INTERNATIONAL REGULATIONS, STANDARDS, CODES AND RECOMMENDATIONS ON CARRIAGE OF DANGEROUS CARGOES

Instructors should refer to the IMO references concerning this topic and design exercises to let officers practice using information contained in the IMDG Code, the BC Code and the IBC Code.

2.2.2 CARRIAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES

Dangerous goods in packages
Trainees should be able to use the IMDG Code to find the information, stowage requirements and precautions to take for a given substance. They should also find the correct emergency schedule and the relevant entry in the MFAG for that substance. Given several substances, they should be able to determine the required segregation between them, including applications to containers and ro-ro units.

It should be pointed out to trainees that safety in the handling and carriage of dangerous goods is primarily ensured by the specification of stringent packaging requirements. Damaged packages should not be accepted for loading.

Solid bulk cargoes
This section deals with the IMO Code of Safe Practice for Solid Bulk Cargoes, R11.

A ship may be required to carry a substance not included in the Code. The master should obtain all relevant information about its properties before loading it. The type of information included in the Code should be used as a guide to what questions should be asked.

Previous loading practices and maintenance activity appear to be important factors in the safety of dry bulk carriers. Instructors should explain the problems suffered by some single skin dry bulkers in the early 1990s. The majority were over 15 years of age and were carrying iron ore at the time of the loss. Masters and chief officers should be able to identify potential weak points and carry out routine inspections to detect unsafe conditions and take appropriate actions. Focus should be on the structural arrangements and hull integrity with emphasis on the critical areas of the structure: hatch corners, coamings; main frames and brackets; topside tanks; transverse bulkheads and any damage caused during cargo handling.

IACS classification societies introduced an enhanced survey programme (ESP) for bulkers and tankers in 1993 covering the preparation and planning of hull surveys, harmonized bottom survey in dry dock with class renewal survey, maintenance of a survey documents file on board and corrosion prevention measures (T69, V4). This was adopted in Chap XI of SOLAS as regulation 2 Enhanced Surveys, applicable to oil tankers and bulk carriers from July 1998.

The IMO grain rules
An example of a grain loading calculation should be made by students.

Part C2: Detailed Teaching Syllabus

Introduction

The detailed teaching syllabus is presented as a series of learning objectives. The objective, therefore, describes what the trainee must do to demonstrate that the specified knowledge or skill has been transferred.

Thus each training outcome is supported by a number of related performance elements in which the trainee is required to be proficient. The teaching syllabus shows the Required performance expected of the trainee in the tables that follow.

In order to assist the instructor, references are shown to indicate IMO references and publications, textbooks and teaching aids that instructors may wish to use in preparing and presenting their lessons.

The material listed in the course framework has been used to structure the detailed teaching syllabus; in particular,

Teaching aids (indicated by A)
IMO references (indicated by R) and
Textbooks (indicated by T)

will provide valuable information to instructors.

Explanation of Information Contained in the Syllabus Tables

The information on each table is systematically organised in the following way. The line at the head of the table describes the FUNCTION with which the training is concerned. A function means a group of tasks, duties and responsibilities as specified in the STCW Code. It describes related activities which make up a professional discipline or traditional departmental responsibility on board.

In this model course there are three functions:

Navigation at the Management Level
Cargo Handling and Stowage at the Management Level
Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

The header of the first column denotes the **COMPETENCE** concerned. Each function comprises a number of competences. For example, the Function 2, Cargo Handling and Stowage at the Management Level, comprises two COMPETENCES. Each competence is uniquely and consistently numbered in this model course.

The first is **Plan and Ensure Safe Loading, Stowage and Securing, Care During the Voyage and Unloading of Cargoes.** It is numbered 2.1, that is the first competence in Function 2. The term competence should be understood as the application of knowledge, understanding, proficiency, skills, experience for an individual to perform a task, duty or responsibility on board in a safe, efficient and timely manner.

Shown next is the required **TRAINING OUTCOME**. The training outcomes are the areas of knowledge, understanding and proficiency in which the trainee must be able to demonstrate knowledge and understanding. Each COMPETENCE comprises a number of training outcomes. For example, the above competence comprises a total of six training outcomes. The first is in **APPLICATION OF INTERNATIONAL REGULATIONS, CODES AND STANDARDS**. Each training outcome is uniquely and consistently numbered in this model course. That concerned with application of international regulations, codes and standards concerning safe handling, stowage, securing and transport of cargoes is uniquely numbered 2.1.1. For clarity training outcomes are printed in black on grey, for example **TRAINING OUTCOME**.

Finally, each training outcome embodies a variable number of Required performances – as evidence of competence. The instruction, training and learning should lead to the trainee meeting the specified Required performance. For the training outcome concerned with international regulations, codes and standards concerning safe handling, stowage, securing and transport of cargoes, there is a single area of performance. This is:

2.1.1.1 Plans and actions conform with international regulations

Following each numbered area of Required performance there is a list of activities that the trainee should complete and which collectively specify the standard of competence that the trainee must meet. These are for the guidance of teachers and instructors in designing lessons, lectures, tests and exercises for use in the teaching process. For example, under the topic 2.1.1.1 Plans and actions conform with international regulations, to meet the Required performance, the trainee should be able to:

- plan passage to comply with Loadline Convention correctly conforming with:
  - vessel loading
  - seasonal restrictions, etc
- plan cargo stowage and carriage in compliance with the Code of Safe Practice for cargo stowage and securing
- state that an approved cargo securing manual is required to be carried on board all ships except those engaged solely in the carriage of bulk cargoes

and so on.

IMO references (Rx) are listed in the column to the right hand side. Teaching aids (Ax), videos (Vx) and textbooks (Tx) relevant to the training outcome and required performances are placed immediately following the **TRAINING OUTCOME** title.

The columns to the right hand side list IMO references (Rx), textbooks (Tx) and teaching aids (Ax) relevant to the competence, outcome and required performance.

Note, it is not intended that lessons are organised to follow the sequence of Required performances listed in the Tables. The Syllabus Tables are organised to match with the competence in the STCW Code Table A-II/2. Lessons and teaching should follow college practices. It is not necessary, for example, for celestial navigation to be studied before terrestrial and coastal navigation. What is necessary is that all the material is covered and that teaching is effective to allow trainees to meet the standard of the Required performance.

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

TRAINING OUTCOMES:

STCW Code
Table A-II/2

Demonstrates a knowledge and understanding of:

2.1.1 APPLICATION OF INTERNATIONAL REGULATIONS, CODES AND STANDARDS CONCERNING SAFE HANDLING, STOWAGE, SECURING AND TRANSPORT OF CARGOES

2.1.2 EFFECT ON TRIM AND STABILITY OF CARGOES AND CARGO OPERATIONS

2.1.3 STABILITY AND TRIM DIAGRAMS AND STRESS-CALCULATING EQUIPMENT

2.1.4 STOWAGE AND SECURING OF CARGOES ON BOARD SHIP, CARGO-HANDLING GEAR AND SECURING AND LASHING EQUIPMENT

2.1.5 LOADING AND UNLOADING OPERATIONS, WITH SPECIAL REGARD TO THE TRANSPORT OF CARGOES IDENTIFIED IN THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING

2.1.6 GENERAL KNOWLEDGE OF TANKERS AND TANKER OPERATIONS

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

2.1.1 APPLICATION OF INTERNATIONAL REGULATIONS, CODES AND STANDARDS CONCERNING SAFE HANDLING, STOWAGE, SECURING AND TRANSPORT OF CARGOES

R2, R4, R5, R7 R11, R12, R16, R17, R18, R19, R21, R23, R24, R29

Textbooks: T32, T62
Teaching aids: A1, V2

Required performance:

1.1 Plans and Actions Conform with International Regulations (6 hours)

- plans passage to comply with Loadline Convention correctly conforming with:
  - vessel loading
  - seasonal restrictions
  - zones
  - bunker requirements
  - expected weather patterns
- plans cargo stowage and carriage in compliance with the Code of Safe Practice for cargo stowage and securing — R2, Res A.714 (17)
- states that an approved cargo securing manual is required to be carried on board all ships except those engaged solely in the carriage of bulk cargoes
- lists the information provided in the cargo securing manual
- uses data from the cargo securing manual to plan securing a range of cargo types
- lists the certificates required for inspection by port state control officers

2.1.2 EFFECT ON TRIM AND STABILITY OF CARGOES AND CARGO OPERATIONS

Textbooks: T11, T31, T32, T44, T68
Teaching aids: A1

Required performance:

2.1 Draught, Trim and Stability (20 hours) — R1

- given the draughts forward, aft and amidships, calculates the draught to use with the deadweight scale, making allowance for trim, deflection and density of the water
- given a ship's hydrostatic data, the weight and the intended disposition of cargo, stores, fuel and water, calculates the draughts, allowing for trim, deflection and water density
- calculates changes of draught resulting from change in distribution of masses
- calculates changes of draught resulting from change in water density

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- calculates the quantity of cargo to move between given locations to produce a required trim or maximum draught
- calculates how to divide a given mass between two given locations to produce a required trim or maximum draught after loading
- calculates the locations at which to load a given mass so as to leave the after draught unchanged
- given a ship's hydrostatic data and the disposition of cargo, fuel and water, calculates the metacentric height (GM)
- calculates the arrival GM from the conditions at departure and the consumption of fuel and water
- identifies when the ship will have the worst stability conditions during the passage
- calculates the maximum weight which can be loaded at a given height above the keel to ensure a given minimum GM
- constructs a GZ curve for a given displacement and KG and checks that the ship meets the minimum intact stability requirements
- determines the list resulting from a change in distribution of masses
- determines the expected maximum heel during the loading or discharging of a heavy lift with the ship's gear
- calculates the increased draught resulting from the heel

2.1.3 STABILITY AND TRIM DIAGRAMS AND STRESS-CALCULATING EQUIPMENT

Textbooks: T11
Teaching aids: A1

Required performance:

3.1 Shear Forces, Bending Moments and Torsional Moments (8 hours) — R1, R4, R5

- states that the carriage of loading calculators in large ships carrying dry or liquid cargo in bulk is a requirement of the classification societies
- states that the maximum permissible values of shear force and bending moment in harbour and at sea are laid down by the classification societies
- states that maximum torsional moments are also laid down for some container ships
- describes the use of typical cargo loading instruments and lists the information obtainable from them
- explains that harbour stress limits should not be exceeded during loading, discharging or ballasting operations and that it is not sufficient just to finish within the limits

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- explains that sufficient information to arrange for the loading and ballasting of the ship in such a way as to avoid the creation of unacceptable stresses should be on board, unless the Administration considers it unnecessary for that ship

3.2 Compliance with the Minimum Freeboard Requirements of the Load Line Regulations (6 hours)

- uses the chart of zones and seasonal areas to determine the load lines which apply for a particular passage
- given the ship's hydrostatic data and the daily consumption of fuel and water, determines the minimum departure freeboard and quantity to load, taking into account the zones, seasonal zones and areas through which the ship will pass — R1, R4, R5
- calculates the maximum quantity to load, taking account of loading, discharging and bunkering at an intermediate port or ports, so as to comply throughout with the load line regulations

3.3 The use of Vector Diagrams to Calculate Stresses on Cargo Gear (6 hours) — R1, R17, R18, R19

- draws vector diagrams of force for a given rig and load to determine:
  - the stress on head fittings of cargo, heel and topping-lift blocks
  - the tension in the span
  - compression in the derrick
- determines the values in the above, making an allowance for friction at moving sheaves
- determines, by drawing, the tension in the runners of a union-purchase rig
- explains why the angle between the runners should not be allowed to exceed 120°
- determines, by drawing, the tension in slings supporting a load, in the lifting legs for pontoon hatch covers and in similar lifting arrangements

3.4 Use of Automatic Data Based (ADB) Equipment (2 hours) — R1

- provides an understanding of information obtained from ship stress indicators and loading programmes
- use of stress indicators and loading programmes in planning for the safe carriage of dry and liquid cargoes
- advantages and limitations of analogue and digital stability and loading programmes

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

2.1.4 STOWAGE AND SECURING OF CARGOES ON BOARD SHIP, CARGO-HANDLING GEAR AND SECURING AND LASHING EQUIPMENT

Textbooks: T62, T70
Teaching aids: A1

Required performance:

R1, R12, R16, R17, R18, R19, R23, R24

4.1 Timber Deck Cargoes (3 hours)

- outlines the contents of the Code of Safe Practice for Ships Carrying Timber Deck Cargoes with respect to:
  – stowage of sawn timber, logs, cants and wood pulp
  – fitting of uprights
  – lashings and the arrangements for tightening them, including the use of a wiggle wire
- states that vibration and movement of the ship in a seaway compacts the stow and slackens the lashings
- states that lashings should be inspected regularly and tightened as necessary
- states that inspections of lashings should be entered in the log-book
- explains the dangers of heavy seas breaking aboard and how to minimize that risk
- states the action to take if cargo is lost overboard or jettisoned
- states the maximum height of cargo permitted on deck in a seasonal winter zone in winter
- describes the controlling factors for height of cargo at other times
- describes the requirements for fencing, for provision of walk-ways and for access to the top of the cargo
- describes the requirements when loading to timber load lines
- lists the stability information that should be available to the master
- explains when the worst stability conditions during a voyage are likely to occur
- describes the rolling period test for the approximate determination of a ship's stability and the limitations of the method
- explains the actions to take in the event of the ship developing an angle of loll

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

4.2 Procedures for Receiving, Tallying and Delivering Cargo (3 hours) R1

- states that the master is responsible for goods from the time of their passing the rail during loading to passing the rail at discharging
- describes how tallying should be done
- states that the ship's tally should be compared with that of the cargo interests and agreed or any differences investigated
- states that valuable cargoes should be tallied by a ship's officer and stowed in lockers
- states that damaged packages should be rejected, for re-coopering or checking of contents
- explains that bills of lading are drawn up from mate's receipts and the importance of endorsing mate's receipts for the condition of goods and packages
- describes the endorsement of mate's receipts for goods in dispute
- describes the endorsement of mate's receipts for cargoes where the weight and quality are not known to the ship
- explains the actions to take when a clean mate's receipt or bill of lading is demanded for cargo which is not in apparent good condition
- explains why letters of indemnity offered in return for clean bills of lading should be refused
- states that a note should be made in the tally book when a mate's receipt is issued to prevent the possibility of signing a second receipt for the same consignment
- describes the documentation which should accompany dangerous goods and is required before loading
- states that containers should have their seals and locks in place when loaded
- states that, if damage to cargo is suspected, protest should be noted before commencing discharging
- explains the procedure for noting protest and extending protest
- states that an independent cargo survey should be arranged when cargo damage is suspected or found on opening hatches
- states that broken or broached packages should be placed in a locker until the contents can be checked and agreed with a representative of the receiver and a receipt obtained for them
- explains how to deal with empty bags or packages, sweepings and other loose goods
- states that cargo spaces should be searched at the completion of discharging to prevent the over carriage of cargo
- describes the procedure for claiming for damage done to the ship during loading or discharging
- explains to whom cargo should be delivered

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

4.3 Care of Cargo During Carriage (4 hours) — R1

- given a cargo list, uses reference books to plan the stowage of a hold or holds, taking account of the carriage requirements of the various cargoes
- describes the precautions to avoid crushing and chafing damage and states which cargoes are most liable to be affected
- explains how cargo may be damaged by residues of previous cargo, dirty dunnage or leaking fuel oil tanks
- describes how cargo can be damaged by dust and the precautions to take when carrying commodities giving rise to dust
- states which cargoes are particularly liable to damage by ship or cargo sweat and explains how to minimize the risk of sweat damage
- explains that any goods containing liquids are liable to leak and describes the stowage required to prevent any leakage damaging other goods
- states that many goods can be spoiled by extremes of temperature
- explains that overheating may occur in cargo stowed against engine-room bulkheads, heated double-bottom tanks and deep tanks carrying heated cargoes
- states that high temperatures also occur on the underside of steel decks exposed to tropical sunshine
- describes how to protect cargoes which must be kept from freezing
- describes the measures to take to prevent pilferage of cargo during loading, discharging and carriage
- describes the damage to cargo which can result from the use of fork-lift trucks and similar machinery in cargo spaces and methods of preventing it

4.4 Requirements Applicable to Cargo-handling Gear (4 hours) — R1, R22

- outlines the requirements of ILO Convention 152, the Occupational Safety and Health (Dock Work) Convention, 1979, which apply to ships
- defines the terms:
  - competent person
  - responsible person
  - authorized person
  - lifting appliance
  - loose gear
- states that national laws or regulations should prescribe measures to cover, amongst others:
  - safe means of access to ships, holds, staging, equipment and lifting appliances
  - opening and closing of hatches, protection of hatchways and work in holds
  - construction, maintenance and use of lifting and other cargo- handling appliances
  - rigging and use of ship's derricks
  - testing, examination, inspection and certification, as appropriate, of lifting appliances, of loose gear (including chains and ropes) and of slings and other lifting devices which form an integral part of the load
  - handling different types of cargo
  - dangerous substances and other hazards in the working environment

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- describes the requirements for guarding dangerous parts of machinery
- states that machinery includes mechanized hatch covers and lifting appliances
- states the requirements for the marking of beams and portable hatch covers
- states that only an authorized person, preferably a member of the ship's crew, should be permitted to open or close power-operated hatch covers and equipment such as doors in hull, ramps and car decks
- describes the requirements for fencing of openings
- describes the requirements for the testing of lifting appliances and loose gear before they are used for the first time
- describes the requirements for periodic thorough examination and inspection of lifting appliances and loose gear
- explains what is meant by a thorough examination
- describes the records and certificates which should be kept in respect of tests, thorough examinations and inspections of lifting appliances and loose gear
- describes the marking of safe working loads required on lifting appliances and loose gear
- states that every ship must have a rigging plan and relevant information necessary for the safe rigging of derricks and accessory gear

4.5 Maintenance of Cargo Gear (3 hours) — R1, R20

- states that the plan should be amended when any changes to the attached gear are made
- describes the maintenance of wire ropes used with lifting appliances
- lists the points to look for when inspecting wire ropes
- describes the amendments to be made to the rigging plan when a wire rope is renewed
- describes the care of fibre guy ropes
- lists the points to look for when inspecting fibre ropes
- describes the maintenance of cargo blocks
- lists the points to look for during inspection or maintenance of cargo blocks
- explains that blocks should be lubricated daily while in use for cargo handling
- describes how to lift a derrick heel for overhaul and inspection
- states the importance of checking that split pins or other retaining devices for the nuts of pivot bolts have been replaced correctly
- states that loose gear should be checked to see that there is no distortion to such items as chain links or shackles
- states that shackles should be checked to ensure that they are fitted with the correct pins
- states that all gear should be checked to ensure that the safe working load and, where appropriate, identification marks are readable

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- states the requirements for the annealing of wrought iron loose gear
- describes the precautions to be taken when working aloft for the overhaul of cargo gear — R20

4.6 Maintenance of Hatch Covers (2 hours) — R1

- states that trackways should be cleaned of loose material before closing hatches
- states that the tension of draw chains should be adjusted as required
- states that wheels, gears, racks and pinions and other moving parts should be kept lubricated
- states that side cleats and cross-joint wedge mechanisms should be kept greased
- explains that hydraulic systems should be checked for leakage, especially in 'tween-decks where leaked fluid may damage cargo
- states that drainage channels should be cleaned out and drainage holes checked on weather-deck hatches
- describes how to check that compression bars are making complete contact with sealing gaskets
- explains that tightness may be checked by hose-testing the covers before loading

2.1.5 LOADING AND UNLOADING OPERATIONS, WITH SPECIAL REGARD TO THE TRANSPORT OF CARGOES IDENTIFIED IN THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING

Textbooks: T62
Teaching aids: A1

Required performance:

5.1 Loading, Stowage and Discharge of Heavy Weights (3 hours) — R1, R17, R23

- explains how a load should be spread over an area of deck or tank top by the use of dunnage to avoid heavy point loading between beams and floors
- states that special supports or cradles will need to be built for awkwardly shaped lifts
- explains the use of shoring in a tween-deck to spread the load over a larger part of the ship's structure
- states that the ship's stability should be checked to ensure that the resulting list will be acceptable
- states that the weight of the lifting gear should be included in the weight of the lift, both for stability calculations and during consideration of safe working loads

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- explains why double-bottom tanks should be full or empty and the ship upright before starting to load or to discharge
- describes the rigging of a heavy-lift derrick
- states that additional stays may need setting up to a mast or kingpost
- states that all shrouds should be checked and set up to carry an equal load
- states that the derrick and all attachments should be thoroughly inspected before use
- states that winches should be put in double gear, where appropriate
- states that the derrick should be slewed to its full out-reach and back to ensure that the heel fitting is free and that guy leads are clear before lifting the load
- describes the arrangement and rigging of a Stülken derrick
- describes the use of two derrick cranes in tandem and methods of ensuring that the load is equalized between them
- states that only experienced winch drivers should be allowed to handle heavy lifts
- states that all movements should be controlled and steady, avoiding rapid stops and starts
- explains how slewing guys attached to the lower cargo block produce lower stresses than guys at the derrick head
- states that the guys should not be allowed to become slack
- states that steadying lines should be attached to the load when possible
- states that lifting should be stopped as soon as the weight is taken, to check the slinging arrangements and the derrick gear under load
- describes methods of securing heavy lifts in the hold or on deck

5.2 Care of Cargo During Carriage (1 hour) — R1, R23

- outlines the content of the Code of Safe Practice for Cargo Stowage and Securing
- describes how to stow and secure containers on deck on vessels which are not specially designed and fitted for the purpose of carrying containers — R16
- describes the stowage and securing of containers and other cargo units in ships other than cellular container ships — R17, R23
- describes the contents of the cargo-securing manual and its use — R24
- lists the elements to be considered by the master when accepting cargo units or vehicles for shipment — R18, R23
- states that cargo spaces should be regularly inspected to ensure that the cargo, cargo units and vehicles remain safely secured throughout the voyage
- describes the stowage and securing of road vehicles on ro-ro ships — R19

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- describes recommended methods for the safe stowage and securing of:
  - portable tanks
  - portable receptacles
  - wheel-based (rolling) cargoes
  - coiled sheet steel
  - heavy metal products
  - anchor chains
  - metal scrap in bulk
  - flexible intermediate bulk containers
  - unit loads

- summarizes the guidelines for the under-deck stowage of logs

- describes actions which may be taken in heavy weather to reduce stresses on securing arrangements induced by excessive accelerations

- describes actions which may be taken once cargo has shifted

5.3 Methods and Safeguards When Fumigating Holds (2 hours) R1, R14

- explains the reasons for the control of pests

- states that the control of rodents is required by the International Health Regulations

- describes the methods for the prevention of insect infestation and states the areas to which particular attention should be given

- explains how contact insecticides in the form of sprays, smokes or lacquers may be used by the crew for dealing with local infestation

- states that all persons not directly involved in the application should be evacuated from the areas being treated for a period not less than that recommended by the manufacturer of the pesticide

- states that extensive or hazardous treatments, including fumigation and spraying near human or animal food, should only be undertaken by expert operators

- states that a fumigator-in-charge should be designated by the fumigation company or appropriate authority

- lists the information about the fumigation which should be supplied to the master

- states that fumigation of empty cargo spaces should always be carried out in port

- states that crew should remain ashore until the ship is certified gas-free, in writing, by the fumigator-in-charge

- states that a watchman should be posted to prevent unauthorised boarding and warning notices should be displayed

- lists the precautions to be taken if essential crew members are permitted to return before aeration (ventilation) of the ship

- states that entry to spaces under fumigation should never take place except in case of extreme urgency and lists the precautions to be taken if entry is imperative

- states that fumigation in transit should only be carried out in ships approved for such process by the flag State Administration and that the application should be with the agreement of the port State Administration

COMPETENCE 2.1 **Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes** **IMO Reference**

- states that fumigation in transit may be:
  – treatment continued during the voyage in a sealed space in which no aeration has taken place before sailing
  – continuation of in-port fumigation where some aeration has taken place but clearance cannot be issued because of residual gas and the cargo space has been re-sealed before sailing
- states that precautions are the same in both cases
- states that at least two members of the crew, including one officer, who have received appropriate training, should be designated as the trained representative of the master responsible for ensuring safe conditions after the fumigator-in-charge has handed over that responsibility to the master
- states that the trained representative should brief the crew before a fumigation
- lists the training which the designated representatives should have
- lists the items which the ship should carry
- describes the procedures for the fumigation and the handing over of responsibility from the fumigator-in-charge to the master
- describes the safety checks on gas concentration that should be made throughout the voyage and states that the readings should be entered in the log-book
- describes the procedures to follow prior to and on arrival at the discharging port
- describes the precautions to be taken during the discharge of cargo until the ship is certified free of fumigants
- describes the procedures for the carriage of fumigated freight containers, barges and transport units that are loaded after fumigation without ventilation
- states that the master should be informed prior to loading such freight containers, barges and transport units and that they should be identified with suitable warning labels showing the identity of the fumigant and the date and time of fumigation
- describes the methods which may be used for the control of rodents
- describes the use of baits by the ship's crew and the precautions to observe
- explains that the use of pesticides is regulated by Governments, and their use may be limited by the regulations and requirements of:
  – the country where the cargo is loaded or treated
  – the country of destination
  – the country of registration of the ship
- describes the use of pesticides by the ship's crew and the precautions to observe
- describes the measures to be taken if clothing becomes contaminated
- states that, if contact insecticides are to be applied to grain during loading, the master should be provided with written instructions on the type and amount of insecticide to be used and on the precautions to be taken
- states the actions to be taken in the event of exposure to insecticides resulting in illness

COMPETENCE 2.1 **Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes** **IMO Reference**

2.1.6 GENERAL KNOWLEDGE OF TANKERS AND TANKER OPERATIONS

Textbooks: T31, T41
Teaching aids: A1, V1, V6, V7

Required performance:

6.1 Terms and definintions (1 hour) R1, R28

- defines petroleum as crude oil and liquid hydrocarbon products derived from it
- states that petroleum gases, principally methane, are extracted from crude oils before shipment
- explains that 'spiked crude' has additional petroleum gas, usually butane, dissolved in it before shipment
- states that 'sour crude' contains appreciable amounts of hydrogen sulphide or organic sulphur compounds
- states that products derived from crude oil include naphtha (gasolines), kerosine, gas oil, diesel oils, lubricating oils, waxes and residual oils such as fuel oil and bitumen
- explains that vapour pressure of any liquid increases with increasing temperature
- defines Reid Vapour Pressure (RVP)
- explains why the pressure in a tank is not necessarily the same as the RVP of the oil it contains, even at the standard temperature
- states that the flashpoint of a liquid is the lowest temperature at which it gives off sufficient gas to form a flammable mixture in a flashpoint apparatus
- explains why flashpoint cannot be used as an absolute measure of safety
- states that 'flammable' means 'capable of being ignited and of burning'
- defines 'upper flammable limit', 'lower flammable limit' and 'flammable range' and states approximate values for petroleum products
- defines the auto-ignition temperature as the temperature at which a flammable material will ignite without initiation by a spark or flame and will continue to burn
- describes the viscosity of a fluid as a measure of its resistance to flow
- states that viscosity increases as the temperature decreases
- defines 'pour point' as the lowest temperature at which an oil is observed to flow
- appreciates that crude carriers in particular have significant residues in tanks which must be accounted for in order to calculate the cargo loaded
- calculates the volume of dry residue as a uniform layer on the tank bottom
- calculates the volume of liquid residues as a wedge on the tank bottom
- knows the limitation of application of wedge calculation

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

6.2 Contents and Application of the International Safety Guide for Oil Tankers and Terminals (ISGOTT) (2 hours) R1, R28

- explains that ISGOTT contains operational guidance for the safe handling of petroleum on tankers and at terminals
- states that Part I deals with operations and Part II contains supporting technical information R1
- states that terminal, local or national regulations may also be applicable and should be known by those concerned
- outlines the general precautions to be taken on tankers regarding:
  - smoking, matches and cigarette lighters
  - naked lights
  - the galley
  - electrical equipment
  - use of tools
  - entry to enclosed spaces and pump-rooms
- lists the information which should be exchanged between the ship and the terminal before arrival
- states that safety procedures are agreed between the tanker and the terminal and include:
  - means of summoning emergency services
  - availability and use of fire-fighting and other emergency equipment
  - actions to be taken in case of fire or other emergency
  - emergency evacuation of the berth
- states that fire-fighting equipment should be ready for immediate use
- states that main engines and other equipment essential for manoeuvring should be ready for use at short notice and the written agreement of the terminal and port authority should be obtained for any work or repairs which would immobilize the ship
- states that detailed loading or discharging plans are agreed between the ship and the terminal
- explains that safety measures against pollution and actions to take in case of an accident are agreed before transfer of cargo commences
- states that, before starting cargo transfer, the responsible officer and the terminal representative must formally agree that they are ready to do so safely
- states that the terminal should be notified of the intention to use crude oil washing (COW) at least 24 hours in advance
- explains that tanks should be maintained in an inert condition throughout all operations except when entry to tanks for inspection or repair is necessary
- explains that the inert gas should have an oxygen content not exceeding 5% by volume
- states that the oxygen content of cargo tanks should not exceed 8% by volume

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- explains that the inert-gas plant will be used to:
  - inert empty cargo tanks
  - supply inert gas during cargo discharging, deballasting, crude oil washing and tank cleaning
  - purge tanks prior to gas-freeing
  - top-up the pressure when necessary during a voyage
- explains that, in the event of a failure of the inert gas system, discharge of cargo or ballast or tank cleaning should be stopped, to prevent air being drawn into the tanks, and operations should only be resumed when a supply of inert gas has been restored
- describes the hold and tank arrangements of combination carriers
- describes the safety aspects relating to the operation of double hull tankers
- outlines the change-over from oil to dry bulk cargo and from dry bulk cargo to oil

6.3 Oil Tanker Operations and Related Pollution-prevention Regulations (3 hours) — R1, R28

- defines 'segregated ballast', 'clean ballast', 'dirty ballast', 'slop tank'
- briefly describes an inert gas system (IGS) and sketches the distribution of inert gas to tanks
- explains the reasons for ballasting
- states that the capacity and arrangement of segregated ballast tanks is intended to provide sufficient weight, to provide a satisfactory trim and to ensure full immersion of the propeller for normal conditions of sea passages
- states that on rare occasions weather conditions may be so severe that additional ballast is needed for the safety of the ship
- states that in crude oil tankers equipped with COW the additional ballast would be carried in tanks that have been washed with crude oil
- states that the additional ballast must be treated as dirty ballast
- explains why a ship may have only clean or segregated ballast on board upon arrival at a loading port
- states the criteria for the discharge of oil from cargo-tank areas of oil tankers
- outlines the procedures for changing ballast at sea
- states that, before loading clean ballast, cargo pumps and lines to be used are flushed with clean water into a dirty ballast or slop tank
- describes how to dispose of dirty ballast
- describes how to decant the water contents of the slop tank
- states that a final flushing of cargo pumps and lines to be used for discharge of clean ballast is made to the sea through the oil monitoring and control system
- explains that the operation of discharging dirty ballast, decanting the slop tanks and flushing lines must be done when more than 50 nautical miles from the nearest land and outside a special area

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- states that only segregated or clean ballast may be discharged within 50 nautical miles of land or inside a special area
- explains the reasons for tank cleaning
- briefly describes the use of fixed and portable machines for tank cleaning
- describes the use of slop tanks during tank cleaning
- states that an inert atmosphere should be maintained in tanks during tank cleaning in ships fitted with IGS
- briefly describes crude oil washing and the reasons for requiring it in crude oil tankers of 20,000 dwt and above
- states that crude oil washing can only be carried out with fixed washing machines in inerted tanks
- states that the oil residues in the slop tank resulting from tank cleaning and disposal of dirty ballast may be:
  - pumped ashore at the loading terminal
  - retained on board and segregated from the next cargo
  - retained on board and the new cargo loaded on top of them
- states that the process of tank cleaning, changing ballast, decanting the water from slop tanks and loading the next cargo over the retained oil is known as the load-on-top procedure
- states that details of cargo operations, ballasting and deballasting, tank cleaning, discharge of water from slop tanks and disposal of residues are entered in the ship's Oil Record Book
- defines gas-freeing as the replacement of hydrocarbon vapours or inert gas by air
- lists the reasons for gas-freeing
- explains why inert gas is used to purge the tanks of hydrocarbon vapours before introducing air on suitably equipped ships
- states that a mechanical fixed system is used or portable fans are used
- states that checks are made during gas-freeing with combustible-gas indicators, oxygen metres and toxic-gas detectors
- states that the supply of inert gas to the tank is shut off
- explains the need to maintain ventilation and to check the atmosphere frequently when persons are working in a tank
- appreciates that the change of volume with temperature of oils is not linear
- states that cargo calculation is carried out as if the oil were at a standard temperature
- understands that the volume of the oil must be corrected from its actual temperature when measured to the standard temperature
- states that the cargo calculation is carried out as if the density of the oil was that at the standard temperature
- explains that the density of oil must be corrected from its actual density to that at the standard temperature

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

– appreciates that different types of oils have different coefficients of expansion and that there are separate Petroleum Measurement Tables for Crude Oils, Products and Lubricating Oils

– understands the difference between mass and weight in air and that one or the other may be required by different administrations

6.4 Chemical Tankers (3 hours) — R1, R25, R27

– states that modern chemical tankers have evolved from oil product tankers to take account of special carriage requirements and associated hazards

– explains that dedicated service usually means that the tanker is designed for the carriage of a particular type of chemical and transports the same type of cargo on each voyage

– explains that a chemical tanker engaged in parcel trade moves a variety of relatively small lots of chemicals between a number of ports

– lists the most important of the rules governing chemical tankers as:
  - international rules and regulations
  - national rules and regulations
  - classification society rules

– states that the sea transport of liquid chemicals in bulk is internationally regulated, as regards safety and pollution aspects, through Conventions adopted by the International Maritime Organization (IMO)

– explains that the Convention requirements are supplemented by recommendations, specifications and Codes adopted by IMO

– states that the IMO Conventions covering the carriage of chemicals in bulk are: R2
  - the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, Chapter VII
  - the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the 1978 Protocol (MARPOL 73/78), as amended, Annex II R27

– states that the most important Codes and standards covering the transport of liquid chemicals are:
  - the Bulk Chemical Codes
    - Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH Code)
    - International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC) Code R25
  - Standards for Procedures and Arrangements for the discharge of Noxious Liquid Substances (P and A Standards)

– defines a chemical tanker as a cargo ship constructed or adapted and used for the carriage in bulk of any liquid product listed in Chapter 17 of the IBC Code R25

– explains that products are included in the list in Chapter 17 because of their safety hazards or because of their pollution hazards or both R25

– states that safety hazards may be one or more of the following:
  - fire hazard in excess of that of petroleum products
  - toxicity
  - corrosivity
  - reactivity with water, air or other chemicals or self-reaction (polymerization, decomposition)

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- states that, in addition to the survey requirements for any ship, chemical tankers must undergo surveys of the cargo-containment and handling arrangements for the issue of an International Certificate Fitness for the Carriage of Dangerous Chemicals in Bulk — R25
- explains that the Bulk Chemical Codes divide tankers into three ship types, Type 1, Type 2 and Type 3, which reflect the hazard ratings of the cargoes which may be carried — R25
- states that a Type 1 ship is intended for the transportation of products considered to present the greatest overall hazards and Type 2 or Type 3 for products of progressively lesser hazards
- states that the division into ship types is based on the ship's capability to survive specified damage caused by collision or stranding and the location of the cargo tanks in relation to such damage
- illustrates, by means of sketches, the location of tanks for each type of ship
- explains the following descriptions of tanks:
  - independent
  - integral
  - gravity
  - pressure
- states that all materials used for tank construction and associated piping, valves and pumps must be resistant to the cargo carried
- states that some ships have stainless-steel tanks for the carriage of cargoes which cannot be contained in mild steel
- explains that mild-steel tanks are normally coated, to protect cargoes from contamination by steel and to make cleaning, gas–freeing and inspection easier
- states that no single coating is suitable for all cargoes and that the coating manufacturer's compatibility data must be used when planning a cargo
- explains that cofferdams and other void spaces may be included in the cargo-tank area to provide segregation of groups of tanks
- illustrates typical tank arrangements by means of simple sketches
- states that the heating medium may be steam, water or thermal oils
- explains that the heating system may use coils fitted inside the tank or a heat exchanger placed outside the tank
- describes, with the aid of a drawing, a cargo heating system that uses a heat exchanger placed outside the tank
- states that there is suitable protective clothing on board which must be worn by all personnel engaged in loading or discharging operations
- states that, for certain cargoes, there must be respiratory and eye-protection equipment for every person on board for emergency escape
- states that equipment for evaluation of atmospheres in tanks and other enclosed spaces is provided for:
  - detection of flammable gases
  - measurement of oxygen content
  - measurement of concentration of toxic gas

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- describes how to use an absorption tube gas detector for measuring the concentration of a gas
- explains what is meant by:
  – the threshold limit value (TLV) of a product
  – the odour threshold
- states that the atmosphere in tanks and enclosed spaces must be considered dangerous unless appropriate checks prove otherwise
- states that information about cargoes to be handled is essential to the safety of the vessel and crew
- states that information for each product may be found on cargo data sheets contained in safety guides or provided by the manufacturer or shipper
- states that, if sufficient information necessary for the safe handling and carriage of a cargo is not available, the cargo must not be loaded
- states that information necessary for the safe carriage of a cargo includes:
  – a full description of the physical and chemical properties, including reactivity, necessary for its safe containment
  – action to take in the event of spills or leaks
  – countermeasures against accidental personal contact
  – fire-fighting procedures and fire-fighting media
  – procedures for cargo transfer, tank cleaning, gas-freeing and ballasting
  – details of the stabilizer or inhibitor added to those cargoes, which require one (on the manufacturer's certificate, in the absence of which the cargo should be refused)
  – First Aid procedures, including the use of specific antidotes for poisons
- states that tanks are normally subject to thorough inspection and testing for cleanliness before loading
- explains, with the aid of a simple drawing, how cargo is routed from the manifold to tanks on a chemical tanker with separate lines for each tank
- explains, with the aid of a simple drawing, a 'closed circuit' loading operation using a vapour-return line
- states that samples are taken from the lines and tanks during loading for purposes of quality control
- states that visual and audible high-level alarms and a tank overflow control system are required for many chemicals
- states that personnel involved in unloading should check the information in the relevant data sheets and take all necessary precautions, including the wearing of appropriate protective clothing
- states that, prior to discharging, samples from tanks and lines are analysed to check if the product has been contaminated on board during the passage
- explains, with the aid of a simple drawing, how cargo is routed from tank to the manifold on a tanker with deepwell pumps and separate lines from each tank
- states that, in tanks containing cargoes that present a major fire hazard, inert gas or nitrogen is used to maintain a small positive pressure during unloading, to prevent air from entering the tanks

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

6.5 Tank Cleaning and Control of Pollution in Chemical Tankers (2 hours) R1, R27

- states that different cargoes require different tank-cleaning procedures
- states that most tank cleaning can be done with hot or cold seawater or fresh water, or by ventilation alone, although a few cargoes require special solvents
- states that fixed or portable tank-washing machines are used
- lists phases in a tank-cleaning operation as:
  - prewash
  - main wash
  - fresh water rinse
  - gas-freeing
  - drying
  - inspection and testing
- explains the use of slop tanks to hold cargo residues and tank washings
- explains, with the aid of a simple drawing, the cycle of a tank-washing system from the seawater inlet to the slop tank
- states that Annex II of the MARPOL 73/78 Convention contains regulations for the control of pollution by noxious liquid cargoes carried in bulk or tank washings from such cargoes
- states that, for the purposes of Annex II, noxious liquid substances are divided into four categories, A, B, C and D, such that substances in Category A pose the greatest threat to the marine environment and those in Category D the least threat
- states that each ship which is certified for the carriage of noxious liquid substances in bulk must be provided with a Procedures and Arrangements (P and A) Manual that has been approved by the Administration and a Cargo Record Book
- states that the master must ensure that no discharges into the sea of cargo residues or residue/water mixtures containing substances of Category A, B, C or D take place unless they are made in full compliance with the P and A Manual
- states that carrying out operations in accordance with the ship's P and A Manual ensures that the pollution regulations are complied with
- states that pollution-prevention procedures during cargo transfer, ballasting and tank cleaning should include keeping a watch on:
  - levels in cargo, slop or ballast tanks
  - hoses or loading arms
  - pumps, valves, gaskets, connections and hatches
- – spill pans and scuppers
  - alarms and instrumentation
  - co-ordination of operational signals
  - water around vessel
- states that personnel on watch should be present at all times during operations and regularly carry out the inspections mentioned in the above

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- states that entries should be made in the Cargo Record Book, on a tank-to-tank basis, of:
  - loading
  - internal transfer of cargo
  - unloading
  - mandatory prewash in accordance with P and A Manual
  - cleaning of cargo tanks
  - discharge into the sea of tank washings
  - ballasting of cargo tanks
  - discharge of ballast water from cargo tanks
  - accidental or other exceptional discharge
  - control by authorized surveyors

6.6 Gas Tankers (3 hours) — R1, R26

- states that the transport by sea of liquid gases in bulk is internationally regulated with regard to safety, through standards laid down by IMO
- states that Chapter VII of the IMO International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, makes the provisions of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) mandatory — R2
- states that a liquefied gas is the liquid form of a substance that at normal atmospheric temperatures and pressures would be a gas
- states that liquefied gas products transported by gas tankers are listed in Chapter 19 of the IGC Code
- states that some of those substances are also covered by the IBC Code — R25
- divides gas cargoes into four groups as:
  - liquefied natural gas (LNG)
  - liquefied petroleum gas (LPG)
  - liquefied ethylene gas (LEG)
  - chemical gases
- states that LNG is natural gas from which impurities have been removed, and consists mainly of methane
- states that LPG is the common name for petroleum gases consisting mainly of butane and propane
- lists chlorine, ammonia and vinyl chloride monomer as examples of chemical gases
- states that, in addition to the surveys required for all ships, gas tankers must undergo surveys of the cargo-containment equipment and cargo-handling arrangements for the issue of an International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk — R26
- states that the Certificate of Fitness lists the cargoes which may be carried by the ship and may also stipulate conditions for carriage
- explains the following terms used in the IGC Code:
  - boiling point
  - cargo area
  - cargo containment system
  - gas carrier
  - gas-dangerous space or zone
  - gas-safe space
  - hold space

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- interbarrier space
- MARVS
- primary barrier
- secondary barrier
- tank dome

– explains that the IGC divides ships into four types, 1G, 2G, 2PG and 3G

– states that a Type 1G ship is intended for the transportation of products considered to present the greatest overall hazard and Types 2G/2PG and 3G for products of progressively lesser hazards

– states that the division into ship types is based on the ship's capability to survive specified damage caused by collision or stranding and the location of the cargo tanks in relation to such damage

– describes, in simple terms:
- integral tank
- membrane tank
- semi-membrane tank
- independent tank
- internally insulated tank

– explains, in simple terms, the division of independent tanks into:
- Type A, generally a self-supporting prismatic tank
- Type B, generally a self-supporting spherical tank
- Type C, generally a self-supporting cylindrical pressure tank

– illustrates, by means of simple sketches, the different types of tank, showing primary and secondary barriers, insulation and how the tank is supported

– states that cargoes are normally carried as boiling liquids at:
- ambient temperature (fully pressurized), or
- atmospheric pressure (fully refrigerated), or
- intermediate temperature and pressure (semi-refrigerated)

– illustrates, by means of simple sketches, typical tank arrangements in LNG and LPG tankers

– states that the boiling point of gas cargoes ranges from about -162°C for methane to 0°C for butane

– states that all connections and access to a cargo tank are via the tank dome area

– lists the following piping arrangements connected to a cargo tank and describes the purpose of each:
- sample tubes
- vapour line
- condensate line
- stripping/puddle heat line
- liquid line
- spray line
- ventilation line

– states that a cargo tank has shut off valves located as close to the tank as possible for all liquid and vapour connections except for safety relief valves

– states that regulations require remotely operated emergency shutdown (ESD) valves in the cargo piping system

– states that the operation of the ESD system also stops pumps and compressors

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- states that all cargo tanks must be provided with a pressure-relief system
- states that all equipment and piping which can be isolated when full of liquid must be provided with a pressure-relief system
- states that cargo pumps are usually centrifugal, either deepwell pumps or submerged electric pumps, in the tanks with deck-mounted booster pumps, if required
- describes the uses of cargo heaters and vaporizers
- explains the effect of transfer of heat to the cargo on cargo temperature and tank pressure
- states that, except for fully pressurized vessels, means for controlling the pressure must be provided
- states that pressure in cargo tanks may be controlled by:
  – insulation of tanks, to reduce heat transfer
  – leading cargo boil-off to the ship's boilers or main engine as fuel (ONLY with LNG)
  – leading cargo boil-off to the ship's reliquefaction plant, where vapour is liquefied and returned to the tank
  – cooling the liquid in a heat exchanger (indirect system)
- describes the single-stage direct liquefaction cycle
- states that the indirect system is only used for those products which cannot be compressed for safety reasons
- states that inert gas is used to inert hold spaces and interbarrier spaces and to purge tanks
- states that most gas tankers are fitted with an inert-gas generator
- states that the liquid level in cargo tanks is commonly measured by means of float gauges
- states that each cargo tank is fitted with a high-level alarm and automatic shutoff valves to prevent overflow
- states that each cargo tank is fitted with means for indicating the temperature and pressure
- explains how cargo leakage through the primary barrier can be detected
- states that gas tankers have a fixed gas-detection system that gives audible and visual alarms of the accumulation of gas in enclosed spaces such as cargo pump-rooms, compressor rooms, hold spaces and interbarrier spaces
- describes briefly the arrangements for fire fighting on deck in the cargo area
- describes the water-spray system for ships carrying flammable or toxic products

6.7 Cargo Operations in Gas Tankers (2 hours)

- states that information for each product may be found on cargo data sheets contained in safety guides or obtained from the shipper
- states that information needed before loading includes:
  – a full description of the physical and chemical properties that are necessary for the safe containment of the cargo

COMPETENCE 2.1	Plan and Ensure Safe Loading, Stowage, Securing, Care During the Voyage and Unloading of Cargoes	IMO Reference

- action to be taken in the event of spills or leaks
- counter-measures against accidental personal contact
- fire-fighting procedures and fire-fighting media
- procedures for cargo transfer, gas-freeing, ballasting, tank cleaning and changing cargoes
- special equipment for particular cargoes
- minimum temperatures of the inner hull steel
- emergency procedures

– states that products that react when mixed should only be loaded if the complete cargo systems are separated

– states that personnel should be made aware of the hazards and be required to use the appropriate protective equipment provided

– states that the master should ensure proper liaison between the ship and the terminal before and throughout cargo-transfer operations

– describes briefly the following cargo operations:
- drying
- inerting
- purging
- cooling down
- loading
- cargo conditioning on passage
- discharging
- changing cargoes
- gas-freeing
- preparing for tank inspection

– states that all operations involving cargo, ballast and bunkers should be carried out in accordance with the applicable international and local pollution regulations

– states that some gas cargoes are subject to the regulations of Annex II of MARPOL 73/78 — R27

– explains that a gas tanker requires an International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk (NLS Certificate) to carry such products

– states that such cargoes must be handled in accordance with the Procedures and Arrangements Manual

– understands that the mass of vapour present in the ullage space is included in the calculation of liquefied gasses

– calculates the vapour mass

COMPETENCE 2.2	Carriage of Dangerous Cargoes	IMO Reference

TRAINING OUTCOMES:

STCW Code
Table A-II/2

Demonstrates a knowledge and understanding of:

2.2.1 INTERNATIONAL REGULATIONS, STANDARDS, CODES AND RECOMMENDATIONS ON CARRIAGE OF DANGEROUS CARGOES

2.2.2 CARRIAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES

COMPETENCE 2.2 Carriage of Dangerous Cargoes **IMO Reference**

2.2.1 INTERNATIONAL REGULATIONS, STANDARDS, CODES AND RECOMMENDATION ON CARRIAGE OF DANGEROUS CARGOES

Textbooks:
Teaching aids: A1

Required performance:

1.1 International Regulations and Codes (2 hours) R7, R8, R9, R10, R11, R25, R27

- understands the content and applies the of International Regulations Standards, Codes and Recommendations on the carriage of dangerous cargoes, including the International Maritime Dangerous Goods (IMDG) Code and the Code of Safe Practice for Solid Bulk Cargoes (BC Code)
- plans loading, stowage and segregation in accordance with the IMDG Code
- plans loading and stowage in accordance with the IBC Code

2.2.2 CARRIAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES

Textbooks: T32
Teaching aids: A1, V2, V4

Required performance:

2.1 Dangerous Goods in Packages (10 hours)

- describes the requirements of SOLAS chapter VII on the carriage of dangerous goods R2
- explains that the IMDG Code should be followed to ensure compliance with the requirements of SOLAS for the carriage of dangerous goods in packaged form R7
- explains that the Code ensures safety mainly by stipulating the packaging required and the segregation from other cargoes with which there could be an adverse reaction
- states why damaged or leaking packages should not be accepted until they have been checked and repaired and declared to be in satisfactory condition for carriage
- describes the contents of the shipper's declaration of dangerous goods
- states that a packing certificate is also required, certifying that a container or vehicle has been properly packed and secured, if loaded with dangerous goods
- identifies the marking and labelling required on packages or cargo units R8
- states why additional labelling may be necessary to meet the requirements for through transport

COMPETENCE 2.2 Carriage of Dangerous Cargoes	IMO Reference
– lists the contents of volume I of the IMDG Code including: – application of the Code – classification of dangerous goods – documentation – marking and labelling – packaging – specifications for portable tanks and road-vehicle tanks – stowage and segregation, including the segregation of cargoes in container ships and ro-ro ships – fire prevention and fire fighting – marine pollutants	R7
– describes the information given for individual substances	
– states that an index of dangerous goods is included in Volume I of the IMDG Code	
– explains how to obtain the references to the relevant Emergency Schedule (EmS) and the entry in the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG)	R9
– states the requirement for a dangerous goods manifest or stowage plan and describes how they should be prepared	
– lists the explosives which may be carried on a passenger ship	
– lists, by headings, the information given in an emergency schedule	
– given a loading list of dangerous goods, uses the IMDG code to plan a stow and segregation and extracts the relevant references to EmS and MFAG	R7, R9, R10
– defines 'dangerous substances', 'port authority', 'regulatory authority', 'designated port officer' and 'responsible person' as used in the Recommendations on the Safe Transport, Handling and Storage of Dangerous Substances in Port Areas	R13
– explains that a port authority may be empowered to refuse dangerous substances if it is considered that their presence would endanger life or property because of: – their condition – the condition of their containment – the condition of their mode of conveyance – conditions in the port area	
– states that, if any dangerous substance constitutes an unacceptable hazard, the port authority should be able to order the removal of such substance or any ship, package, container, portable tank or vehicle containing it	
– states that a port authority will normally require notification at least 24 hours in advance of the transport or handling of dangerous substances, including those which are not for discharge at that port	
– describes the inspections which may be made by a port authority	
– states that the designated port officer should be empowered to: – direct when and where a ship having any dangerous substances on board may anchor, moor or berth – direct a ship to be moved within or to leave the port area – attach conditions appropriate to local circumstances and the quantity and nature of the dangerous substances	
– states that the regulatory authority may require signals to be shown while transporting or handling dangerous substances	

COMPETENCE 2.2	Carriage of Dangerous Cargoes	IMO Reference

- describes the signals as:
  - by day, flag 'B' of the International Code of Signals
  - by night, an all-round fixed red light
- explains how effective communications with the port authority can be maintained
- describes the requirements regarding mooring a ship carrying dangerous substances
- states that at all times there should be sufficient crew on board to maintain a proper watch and operate appliances in the case of an emergency, taking into account the nature and quantity of dangerous substances on board
- states that a responsible person should be designated to supervise the handling of dangerous goods
- lists the measures which should be taken by the responsible person in connection with:
  - the weather
  - lighting
  - protective clothing and equipment
  - intoxicated persons
  - fire and other emergency procedures
  - reporting of incidents and safety precautions
- states that the port authority should be informed of the intention to carry out repair work when dangerous substances are on board
- explains the handling precautions which should be observed regarding:
  - avoidance of damage to packages
  - access to handling areas
  - lifting goods over dangerous goods stowed on deck
  - escape of a dangerous substance from a package
  - entry into enclosed spaces
- describes the special precautions for loading or unloading explosives — R13

2.2 Solid Bulk Cargoes (9 hours) — R1, R11

- outlines the contents of the IMO Code of Safe Practice for Solid Bulk Cargoes (BC Code)
- states that the main hazards associated with the shipment of bulk solids are:
  - structural damage due to improper distribution of the cargo
  - loss or reduction of stability during a voyage
  - chemical reactions
- explains how to distribute a high-density cargo between holds when detailed information is not available
- states that the loading calculator should be used to check the suitability of a proposed stow for stresses and stability
- states that the data in the ship's stability information book should be used where appropriate
- describes how to prevent shifting of bulk cargo loaded in a tween-deck space to reduce an excessively high GM
- describes precautions to take before, during and after loading of bulk cargo
- describes the precautions to take to minimize the effect of dust on deck machinery, navigational aids and living quarters

COMPETENCE 2.2 Carriage of Dangerous Cargoes	**IMO Reference**
– describes the health hazards which may be associated with bulk materials	
– states that safety precautions and any appropriate national regulations should be complied with during the handling and carriage of bulk materials	
– states that a copy of the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods should be on board	R9
– lists the information which should be supplied by the shipper to the master before loading	
– states that a certificate stating the relevant characteristics of the material should be provided to the master at the loading point	
– explains that certificates stating transportable moisture limits should be accompanied by a statement that the moisture content is the average moisture content at the time of presenting the certificate	
– describes how to trim cargoes having an angle of repose: – less than or equal to 35 degrees – greater than 35 degrees	
– describes how to stow material which flows freely like grain	
– states that the BC code contains a method for determining angle of repose on board ship	
– describes the types of cargo which may liquefy during carriage	
– states that cargoes which may liquefy should not be carried with a moisture content above that of the transportable moisture limit	
– explains that such cargoes may look relatively dry when loaded but liquefy as a result of compaction and vibration during the passage	
– states that such cargoes should be trimmed reasonably level, regardless of the angle of repose stated	
– explains the precautions to be taken to keep liquids out of holds where such cargoes are carried and the danger of using water to cool a shipment of these materials	
– states that specially fitted or constructed cargo ships may carry materials with a moisture content above the transportable moisture limit if approved by their Administrations	
– describes the test for approximately determining the possibility of flow which may be carried out on board ship	
– states that some materials transported in bulk present hazards because of their chemical properties	
– explains that some materials are classified as dangerous goods in the IMDG code while others are 'Materials Hazardous only in Bulk' (MHB)	R9
– states that a list of bulk materials possessing chemical hazards is contained in appendix B of the BC code	
– explains the list of materials possessing chemical hazards is not exhaustive, that the properties listed are for guidance only and that it is essential to obtain currently valid information about bulk materials before loading	
– explains the use of the tables for segregation between incompatible bulk materials and between bulk materials and dangerous goods in packaged form	

COMPETENCE 2.2	Carriage of Dangerous Cargoes	IMO Reference

- states that the IMDG code should also be consulted for additional requirements regarding the stowage and segregation of packaged dangerous goods
- states that particular care should be taken with the segregation of toxic substances and foodstuffs
- states that emergency schedules for materials listed in appendix B are contained in appendix E of the BC code
- uses the BC code to extract all necessary information for the safe carriage in bulk of a stated cargo, describes how it should be loaded and lists any special precautions or requirements to be observed during loading, carriage and discharge

2.3 The IMO Grain Rules (7 hours) R1, R2

- explains that the IMO Grain Rules are based on the recognition that in a compartment nominally filled with grain there exists a void space between the surface of the grain and the deckhead of the loaded equipment
- explains that the Regulations assume a pattern of movement of grain in the void spaces above the grain surfaces which gives rise to adverse heeling effects
- explains that the Regulations require demonstration, by calculation, that at all times during a voyage the ship will have sufficient intact stability to provide adequate dynamic stability after taking into account the adverse heeling moments
- states that the Regulations stipulate the minimum level of acceptable stability for the carriage of grain in terms of initial metacentric height, angle of heel due to assumed grain shift and residual dynamic stability
- states that the Grain rules apply to all ships to which the SOLAS regulations apply and to cargo ships of less that 500 gross tons
- defines the following terms as used in chapter VI of SOLAS:
  - grain
  - filled compartment
  - partly filled compartment
  - angle of flooding
- explains the importance of trimming to fill all of the spaces under decks and hatch covers to the maximum extent possible
- states the intact stability requirements for a ship carrying bulk grain
- states that the ability to comply with the stability criteria may have to be demonstrated before loading
- states that the master should ensure that the ship is upright before proceeding to sea
- describes the use and fitting of longitudinal divisions in both filled and partly filled compartments
- states that the scantlings for uprights and shifting boards are contained in Part C of the Grain Rules
- describes the construction of a saucer as an alternative to a longitudinal division in a hatchway
- describes the use of bagged grain or other suitable cargo stowed in the wings and ends of a compartment to reduce the heeling effects of a grain shift

COMPETENCE 2.2	Carriage of Dangerous Cargoes	IMO Reference

- describes methods of securing the free grain surface in partly filled compartments
- states that the hatch covers of filled compartments which have no cargo stowed over them should be secured as laid down in the document of authorization
- explains that all ships loaded with bulk grain should have a document of authorization issued by or on behalf of their Administration
- states that the document of authorization refers to the ship's grain loading stability booklet and associated plans
- explains that the grain loading stability booklet and associated plans contain all of the information necessary to check that a proposed loading plan complies with the stability requirements of the Regulations at all stages of the voyage
- states that the plans show the arrangements and scantlings of temporary fittings to meet the requirements of the Regulations
- states that in some countries a certificate of loading, certifying that the cargo has been loaded in compliance with the Regulations, is required before sailing
- explains the conditions which must be met before a ship without a document of authorization may load grain
- given a ship's data and details of consumption of fuel and of fresh water for an intended voyage, prepares a stowage plan for a cargo of bulk grain and performs the calculations to check that the proposed stowage complies, at all stages of the voyage, with the stability criteria set out in chapter VI of SOLAS 1974

Master and Chief Mate

Function 3:

Controlling the Operation of the Ship and Care for Persons on Board at the Management Level

Master and Chief Mate

Function 3: Controlling the Operation of the Ship and Care for Persons on Board at the Management Level

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Function 3 – Controlling the Operation of the Ship and Care for Persons on Board at the Management Level

Part A3: Course Framework

Aims

This model course aims to meet the mandatory minimum requirements for knowledge, understanding and proficiency in Table A-II/2 of STCW 1995. This function provides the background knowledge to support Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

Objective

This syllabus covers the requirements of the 1995 STCW Convention Chapter II, Section A-II/2. This functional element provides the detailed knowledge to support the training outcomes related to Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

This section provides the background knowledge to support the tasks, duties and responsibilities in:

- controlling trim, stability and stress
- monitoring and controlling compliance with legislation to ensure
  - safety of life at sea
  - protection of the marine environment
- maintaining safety and security of crew and passengers
- developing emergency and damage control plans
- organising and managing the crew
- organising and providing medical care on board

This includes topics such as ship construction and stability, dry-docking, search and rescue, personnel management and contingency planning.

This syllabus covers the requirements of the 1995 STCW Convention – Chapter II, Section A-II/2

Entry standards

Entrants should have successfully completed a course covering the minimum standards required for certification as officer in charge of a navigational watch on ships of 500 gross tonnage or more (see IMO Model Course No. 7.03, Officer in Charge of a Navigational Watch). In addition they should have completed approved seagoing service as officer in charge of a navigational watch in accordance with STCW 1995 regulation II/2, paragraph 2.

Course certificate

On successful completion of the course and assessments, a document may be issued certifying that the holder has successfully completed a course of training which meets or exceeds the level of knowledge and competence specified in Table A-II/2 of STCW 1995, for the function Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

A certificate may be issued only by centres approved by the Administration.

Staff requirements

Instructors shall be qualified in the task for which training is being conducted and have appropriate training in instructional techniques and training methods (STCW Code Section A-I/6). Depending on the complexity of the exercises set, an assistant instructor with similar experience is desirable for certain practical exercises.

Teaching facilities and equipment

A classroom equipped with an overhead projector and a blackboard or flipchart should be provided for teaching the theory of the course and holding group discussions.

The following equipment is recommended:

- a collection of photographs, drawings and plans, illustrating various types of ship and constructional details
- a floating ship stability demonstration model and a flotation tank are desirable. The model should be capable of demonstrating the effects of adding or removing masses, of shifting masses, of suspending masses and of free surface liquid
- for training in the provision of medical care on board, a set of 'Role Play' scenarios should be devised

Teaching aids (A)

A1 Instructor Guidance (Part B of this course)
A2 Video cassette player
A3 Small samples of welding, sectioned to illustrate common welding faults
A4 Loading instrument

Video cassettes

V1 IMO – Safer shipping and cleaner seas (IMO Code No. VID-202)
V2 Preparing the defence (IMO Code No. VID-301)

Available from: IMO Publications Section
4 Albert Embankment
London SE1 7SR, UK
Fax: 44 171 587 3241
URL: www.imo.org

V3 Permit to work (Code No. 621)
V4 Management for seafarers series (Code Nos. 607-612)
V5 Loadline surveys (Code No. 544)
V6 Safety construction survey (Code No. 545)
V7 Safety equipment survey (Code No. 546)
V8 SOLAS Chapter III Series Part 5 – SOLAS Amendments (Code No. 463)
V9 Man overboard (Code No. 644)
V10 STCW & flag state implementation (Code No. 629)
V11 Shipping casualty emergency response (Code No. 467)
V12 The culture gap (Code No. 537)
V13 Onboard training by design (Code No. 489)
V14 The ISM audit (Code No. 575)
V15 STCW & flag state implementation (Code No. 629)
V16 First aid and medical care on board ship series (Code Nos. 564-571)

Available from: Videotel Marine International Ltd
84 Newman Street, London W1P 3LD, UK
Tel : 44 171 299 1800
Fax: 44 171 299 1818
e-mail: mail@videotelmail.com
URL: www.videotel.co.uk

IMO references (R)

R1 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1998 (IMO Sales No. 938), and 1997 Amendments to STCW 95 (IMO Sales No. 945)

R2 International Convention for the Safety of Life at Sea, 1974, as amended (SOLAS) (IMO Sales No. 110) and 1996 Amendments (IMO Sales No. 167)

R3 International Convention for the Safety of Life at Sea, texts of amendments relating to passenger ro-ro ferries adopted on 21 April & 28 October 1988, other amendments adopted on 11 April 1989 (IMO Sales No. 115)

R4 International Convention on Load Lines, 1966 (IMO Sales No. 701)

R5 Supplement relating to the International Convention on Load Lines, 1966 (IMO Sales No. 705)

R6 Intact Stability Criteria for Passenger & Cargo Ships(1987 edition) (IMO Sales No. 832)

R7 IMO Assembly resolution A.513(13) – Amendments to the International Convention on Load Lines, 1966

R8 Amendments to the 1974 SOLAS Convention concerning Radiocommunications for the Global Maritime Distress & Safety System (IMO Sales No. 156)

R9 Guidelines on Surveys required by the 1978 SOLAS Protocol, the International Bulk Chemical Code & the International Gas Carrier Code (IMO Sales No. 858)

R10 PSLS 2/Circ.5

R11 IMO Assembly resolution A.603(15) – Symbols relating to life-saving appliances and arrangements

R12 IMO Assembly resolution A.624(15) – Guidelines on training for the purpose of launching lifeboats & rescue boats from ships making headway through the water

R13 IMO Assembly resolution A.481(XII) – Principles of safe manning

R14 International Maritime Dangerous Goods Code (IMDG Code) (1990 edition) (IMO Sales No. 200)

R15 Code of Safe Practice for Solid Bulk Cargoes (BC Code) (IMO Sales No. 260)

R16 International Code for the Construction & Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) (IMO Sales No. 100)

R17 1983 Amendments to the International Convention for the Safety of Life at Sea, 1974 (SOLAS 1974), Volume III, International Code for the Construction & Equipment of Ships Carrying Liquefied Gasses in Bulk (IGC Code) (IMO Sales No. 104)

R18 Regulations for the Prevention of Pollution by Oil – Annex I, MARPOL 73/78 (MARPOL I) (IMO Sales No. 525)

R19 Regulations for the Prevention by Noxious Liquid Substances in Bulk – Annex II, MARPOL 73/78 (MARPOL II) (IMO Sales No. 512)

R20 International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL) (IMO Sales No. 520)

R21 Inter-Governmental Conference on the Dumping of Wastes at Sea (LDC 1972) (IMO Sales No. 532)

R22 International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969 (Intervention) (IMO Sales No. 402)

R23 International Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC 1969) (IMO Sales No. 410)

R24 Special Trade Passenger Ships Agreement, 1971 & Rules, 1971 (STP 1971) (IMO Sales No. 727)
R25 1973 Protocol on Space requirements for Special Trade Passenger Ships, 1973, & Rules, 1973 (SPACE STP 1973) (IMO Sales No. 734)
R26 Athens Convention relating to the Carriage of Passengers & their Luggage by Sea, 1974 (PAL 1974) (IMO Sales No. 436)
R27 International Convention on Tonnage Measurement of Ships, 1969 (TONNAGE 1969) (IMO Sales No. 713)
R28 IMO Assembly resolution A.494(XII) – Revised interim scheme for tonnage measurement for certain ships
R29 IMO Assembly resolution A.541(13) – Interim scheme for tonnage measurement for certain ships for the purposes of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto
R30 Convention on Facilitation of International maritime traffic, 1965 (FAL 1965) as amended (IMO Sales No. 354)
R31 IMO Assembly resolution A.647(16) – IMO Guidelines on Management for the Safe Operation of Ships and for Pollution Prevention
R32 Convention on Limitation of Liability for Maritime Claims, 1976 (LLMC 1976) (IMO Sales No. 444)
R33 ILO, Maritime Labour Conventions & Recommendations, 2nd ed. (Geneva, ILO 1988) (ISBN 92-2-106340-2)
R34 WHO, International Health Regulations (1969), 3rd annotated ed. (Geneva, WHO 1983) (ISBN 92-4-158007-0)
R35 Comite Maritime International, International Conventions on Maritime Law (Antwerp, CMI Secretariat (Firma Henry Voet-Genicot, Borzestraat 17, B-2000 Antwerp), 1987)
R36 United Nations Conference on the Law of the Sea, Official Records Volume II Plenary Meetings. Geneva, 1958 (United Nations Publications Sales No.58.V.4, Vol. II,) containing:
Geneva Convention on the Territorial sea & the Contiguous Zone, 1958
Geneva Convention on the High Seas, 1958
Geneva Convention on the Continental Shelf, 1958
R37 United Nations Convention on the law of the Sea. New York, 1983 (United Nations Publications Sales No. E.83.V.5)
R38 IMO Assembly resolution A.441(XI) – Control by the Flag State over the owner of a ship
R39 IMO Assembly resolution A.443(XI) – Decisions of the shipmaster with regard to maritime safety & marine environment protection
R40 IMO Assembly resolution A.671(16) – Safety zones & safety of navigation around offshore installations & structures
R41 IMO Assembly resolution A.466(XII) – Procedures for the control of ships
R42 IMO Assembly resolution A.597(15) _ Amendments to the procedures for the control of ships
R43 IMO Assembly resolution A.648(16) – General principles for ship reporting systems & ship reporting requirements, including guidelines for reporting incidents involving dangerous goods, harmful substances and/or marine pollutants
R44 MEPC. 14 (20) – Amendments to Annex I of MARPOL 73/78
R45 MEPC. 16 (22) – Amendments to Annex II of MARPOL 73/78
R46 MEPC. 21 (22) – Amendments to Protocol I to MARPOL 73/78 and the text of the Protocol, as amended, annexed thereto
R47 MEPC. 47 (31)* – Amendments to the annex of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973 (New regulation 26 and other amendments to Annex I of MARPOL 73/78)

R48 MEPC. 51 (32)* – Amendments to the annex of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973 (Discharge criteria of Annex I of MARPOL 73/78)

R49 MEPC. 52 (32)* – Amendments to the annex of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973 (New regulations 13F and 13G and related amendments to Annex I of MARPOL 73/78)

R50 MEPC. 58 (33) – Amendments to the annex of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973 (Revised Annex III)

R51 MEPC.22 (22) – Guidelines for Reporting Incidents involving Harmful Substances and the text guidelines annexed thereto

R52 IMO Assembly resolution A.587 (14) – Arrangements for Combatting Major Incidents or threats of marine pollution

R53 IMO Assembly resolution A.674 (16) – International Co-operation on Oil Pollution Preparedness and Response

R54 MEPC. 54 (32) – Guidelines for the Development of Shipboard Oil Pollution Emergency Plans

R55 Assembly Resolution A.113 (V) – Revised International Code of Signals

R56 International Convention on Salvage, 1989. The London Salvage Convention

R57 IMO Assembly Resolution A.769 (18) – Procedures and arrangements for issuing GMDSS certificates to holders of non-GMDSS certificates

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Details of distributors of IMO publications that maintain a permanent stock of all IMO publications may be found on the IMO web site at http://www.imo.org

Textbooks (T)

T10 Danton, G. The Theory and Practice of Seamanship. 11th ed. London, Routledge, 1996 (ISBN 0-415-15372-7)

T11 Derrett, D.R. Ship Stability for Masters and Mates, 4th ed. Butterworth-Heinemann, 1984, (ISBN 0-7506-0380-1)

T12 Eyres, D.J. Ship Construction, 4th ed. London, Butterworth-Heinemann, 1994 (ISBN 0-7506-1842-6)

T19 Hill, C. Maritime Law, 4th ed. London, Lloyd's of London Press, 1995 (ISBN 1-850-44-888-4)

T30 International Medical Guide for Ships. World Health Organization, 1989

T35 La Date, J. and Van Gemert, L. (Eds). Stability and Trim for the Ship's Officer. 3rd ed, Centreville, Maryland, US, Cornell Maritime Press, 1983 (ISBN 0-87033-297-X)

T54 Ship Captain's Medical Guide. 1985. Department of Transport HMSO published by HMSO

T58 Taylor, D.A. Merchant Ship Construction. 3rd ed. London, Institute of Marine Engineers, 1992 (ISBN 0-9072-0646-8)

T67 Medical First Aid Guide for use in Accidents involving Dangerous Goods (MFAG). 5th.ed.1994. (ISBN 92-801-1322-4)

T69 Bulk Carriers: Guidance and information on bulk cargo loading and discharging to reduce the likelihood of overstressing the hull structures. IACS. London 1997

T70 Code of Safe Working Practices for Merchant Seamen, London. The Stationery Office Publications Centre, 1998 (ISBN 0115518363)

T72 Holder, L.A. Training and Assessment on Board. 2nd ed. London, Witherby & Co Ltd, 1997 (ISBN 1 85609 123 6)

Function 3: Controlling the Operation of the Ship and Care for Persons on Board at the Management Level

Part B3: Course Outline and Guidance Notes

Timetable

No formal example of a timetable is included in this model course.

Development of a detailed timetable depends on the level of skills of the trainees entering the course and the amount of revision work of basic principles that may be required.

Lecturers must develop their own timetable depending on:

- the level of skills of trainees
- the numbers to be trained
- the number of instructors

and normal practices at the training establishment.

Preparation and planning constitute an important factor which makes a major contribution to the effective presentation of any course of instruction.

Lectures

As far as possible, lectures should be presented within a familiar context and should make use of practical examples. They should be well illustrated with diagrams, photographs and charts where appropriate, and be related to matter learned during seagoing time.

An effective manner of presentation is to develop a technique of giving information and then reinforcing it. For example, first tell the trainees briefly what you are going to present to them; then cover the topic in detail; and, finally, summarize what you have told them. The use of an overhead projector and the distribution of copies of the transparencies as trainees handouts contribute to the learning process.

Course Outline

The tables that follow list the 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 officers depending on their experience, ability, equipment and staff available for training.

COURSE OUTLINE

Knowledge, understanding and proficiency	Total hours for each topic	Total hours for each subject area of Required performance
Competence:		
3.1 CONTROL TRIM, STABILITY and STRESS		
3.1.1 FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY		
.1 Shipbuilding materials	3	
.2 Welding	3	
.3 Bulkheads	4	
.4 Watertight and weathertight doors	3	
.5 Corrosion and its prevention	4	
.6 Surveys and dry-docking	2	
.7 Stability	83	102
3.1.2 EFFECT ON TRIM AND STABILITY IN THE EVENT OF DAMAGE AND FLOODING		
.1 Effect on trim and stability of a ship in the event of damage to and consequent flooding of a compartment and countermeasures to be taken	9	
.2 Theories affecting trim and stability	2	11
3.1.3 KNOWLEDGE OF IMO RECOMMENDATIONS CONCERNING SHIP STABILITY		
.1 Responsibilities under the relevant requirements of the International Conventions and Codes	2	2
3.2 MONITOR AND CONTROL COMPLIANCE WITH LEGISLATIVE REQUIREMENTS AND MEASURES TO ENSURE SAFETY OF LIFE AT SEA AND THE PROTECTION OF THE MARINE ENVIRONMENT		
3.2.1 INTERNATIONAL MARITIME LAW EMBODIED IN INTERNATIONAL CONVENTIONS		
.1 Certificates and other documents required to be carried on board ships by international conventions	1	
.2 Responsibilities under the relevant requirements of the International Convention on Load Lines	1	
.3 Responsibilities under the relevant requirements of the International Convention for the Safety of Life at Sea	2	
.4 Responsibilities under the International Convention for the Prevention of Pollution from Ships	3	
.5 Maritime declarations of health and the requirements of the International Health Regulations	4	
.6 Responsibilities under international instruments affecting the safety of the ship, passengers, crew and cargo	23	
.7 Methods and aids to prevent pollution of the marine environment by ships	2	
.8 National legislation for implementing international agreements and conventions	–	36

Teaching staff should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff available for teaching.

Knowledge, understanding and proficiency	Total hours for each topic	Total hours for each subject area of Required performance
3.3 MAINTAIN SAFETY AND SECURITY OF THE SHIP'S CREW AND PASSENGERS AND THE OPERATIONAL CONDITION OF LIFE-SAVING, FIRE-FIGHTING AND OTHER SAFETY SYSTEMS		
3.3.1 KNOWLEDGE OF LIFE-SAVING APPLIANCE REGULATIONS	2	2
3.3.2 ORGANISATION OF FIRE AND ABANDON SHIP DRILLS	–	–
See IMO model courses 2.03 and 1.23 and STCW Code Sections A-VI/3 and *A-VI/2*		
3.3.3 MAINTENANCE OF OPERATIONAL CONDITION OF LIFE-SAVING, FIRE-FIGHTING AND OTHER SAFETY SYSTEMS	–	–
See IMO model courses 2.03 and 1.23 and STCW Code Sections A-VI/3 and *A-VI/2*		
3.3.4 ACTIONS TO BE TAKEN TO PROTECT AND SAFEGUARD ALL PERSONS ON BOARD IN EMERGENCIES	4	4
3.3.5 ACTIONS TO LIMIT DAMAGE AND SALVE THE SHIP FOLLOWING A FIRE, EXPLOSION, COLLISION OR GROUNDING	4	4
3.4 DEVELOP EMERGENCY AND DAMAGE CONTROL PLANS AND HANDLE EMERGENCY SITUATIONS		
3.4.1 PREPARATION OF CONTINGENCY PLANS FOR RESPONSE TO EMERGENCIES	9	9
3.4.2 SHIP CONSTRUCTION INCLUDING DAMAGE CONTROL	4	4
3.4.3 METHODS AND AIDS FOR FIRE PROTECTION, DETECTION AND EXTINCTION	–	
See IMO model course 2.03 and STCW Code Section A-VI/3		
3.4.4 FUNCTIONS AND USE OF LIFE-SAVING APPLIANCES	–	–
See IMO model course 1.23 and STCW Code Section A-VI/2-1		

Teaching staff should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff available for teaching.

Knowledge, understanding and proficiency		Total hours for each topic	Total hours for each subject area of Required performance
3.5	**ORGANISE AND MANAGE THE CREW**		
3.5.1	PERSONNEL MANAGEMENT, ORGANIZATION AND TRAINING ON BOARD SHIP		
.1	Personnel management	10	
.2	Organization of staff	9	
.3	Training on board ships	12	31
3.5.2	RELATED INTERNATIONAL MARITIME CONVENTIONS AND NATIONAL LEGISLATION		
.1	Related international maritime conventions and national legislation	2	2
3.6	**ORGANISE AND MANAGE THE PROVISION OF MEDICAL CARE ON BOARD**		
3.6.1	MEDICAL PUBLICATIONS		
.1	International Medical Guide for Ships	0.5	
.2	International Code of Signals (medical section)	0.5	
.3	Medical First Aid Guide for Use in Accidents Involving Dangerous Goods	3	4

Total for Function 3: Controlling the Operation of the Ship and Care for Persons on Board at the Management Level 211

Teaching staff should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff available for teaching.

Guidance Notes

The following notes are intended to highlight the main objectives or training outcomes of each part of the function. The notes also contain some material on topics which are not adequately covered in the quoted references.

On completion of training for this function officers will have a knowledge of the principal structural members of a ship and methods of construction. They will understand the theory of stability and trim and be able to use tables, diagrams and stress calculators to plan loading and ballasting so as to maintain satisfactory stability and trim (taking account of applicable IMO recommendations concerning intact stability) and to ensure that hull stresses remain within acceptable limits.

The effects of damage to, and the consequent flooding of, a compartment on the trim and stability of a ship and the counter-measures to be taken will be understood.

Officers will also be thoroughly conversant with the certificates required to be on board, their periods of validity and the procedures for their renewal.

The officers will also be aware of their legal obligations and responsibilities concerning international provisions for the safety of the ship, crew, passengers and cargo and for the prevention of pollution from the ship.

They will also be able to follow the correct procedures for all matters concerning the crew; their engagement and discharge, treatment of wages and deductions, discipline and dealing with disciplinary offences, the discharge of a sick seaman abroad, repatriation, deceased seamen and engagement of substitutes.

Officers will have sufficient knowledge of shipping documents related to cargo and the shipowner's liabilities and obligations in respect of charter parties and the carriage of cargo to enable them to protect the ship's interests.

Officers will be capable of organizing and managing the crew for the safe and efficient operation of the ship and be able to draw up an organization for dealing with emergencies. Officers will also know the requirements for training in the operation and maintenance of safety equipment and be able to implement that training on board.

On completion of training for this function officers will be able to use plans and tables or diagrams of stability and trim data to calculate the ship's initial stability, draughts and trim for any given disposition of cargo and other weights. They will also be able to determine whether stresses on the ship are within permitted limits by the use of stress data, calculating equipment or software. The fundamental actions to take in the event of partial loss of intact buoyancy will be understood.

Training concerned with fire prevention and firefighting is covered in IMO model course 2.03.

Training concerned with proficiency in medical care on board ship is covered in IMO model course 1.15.

Function 3: Controlling the Operation of the Ship and Care for Persons on Board at the Management Level

3.1 Control Trim, Stability and Stress

3.1.1 FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY

Shipbuilding materials

It is not the intention that officers have a knowledge of ship design practice or a detailed knowledge of materials. The focus of teaching should be so that they can explain why various kinds of steel are used in different areas of a ship and understand the advantages and disadvantages of alloys in common use, and how they are maintained.

High tensile steel (HTS) has a low corrosion margin and poor resistance to fatigue failures. However, due to a lighter weight of material, compared with mild steel, for the equivalent strength it has been widely used in ship construction.

Brittle fracture occurs when a normally elastic material fractures without any sign of deformation before failure. The structure may not even be highly stressed at the time. The fracture is often initiated at a small notch in a plate edge or at a small fault in a weld. The tendency to brittle fracture is much greater at low temperatures and there is a temperature, depending upon the particular properties of the steel, above which it will not occur. The classification societies specify the use of grade E steel, which has high notch ductility, for those parts of ships above a certain length where thick plates subject to high stresses are found.

Welding

If the training institute has an engineering department with welding facilities, the opportunity to use their expertise and equipment should be taken.

Bulkheads

The subdivision of passenger ships is dealt with in subject area 3.4.2.1, Ship construction and Damage Control.

Watertight and weathertight doors

The provisions of SOLAS for drills and inspections of watertight doors and related damage-control devices have been included with the details of construction and operation.

Corrosion and its prevention

Trainees should not be required to remember the galvanic series for seawater. It should be used for reference when dealing with corrosion cells and the suitability of metals as anodes for sacrificial anodes.

Many paints contain poisonous substances and release toxic fumes as solvents evaporate. The vapours of most paint solvents will produce flammable or explosive mixtures with air in poorly ventilated spaces.

The risks are greatest when using spray equipment in enclosed spaces. Personnel must wear breathing apparatus, sources of ignition must be excluded and ventilation must be provided while work is in progress. Precautions for entering enclosed spaces should be taken after painting has been completed until the paint has thoroughly dried and no risk of release of vapour remains. Manufacturers' instructions regarding protective clothing and safety precautions should be followed.

Surveys and dry-docking

This section deals with the surveys and inspections required by classification societies. The requirements for survey under international conventions are dealt with in subject module 3.2, Maritime Law. The annual inspection required by the International Convention on Load Lines, 1966, is usually carried out by a classification society surveyor, acting on behalf of the flag State Administration. The inspection is similar to that required for the classification society's annual survey.

The hardeners that are used in two-pack (or bi-pack) polyurethane and epoxy paints are toxic and may also cause allergic reactions following contact with skin. Protective clothing and disposable gloves should always be worn when working with these paints.

Stability

Calculations on box-shaped vessels have been introduced at a number of places in this syllabus. They are included to illustrate basic principles and to aid trainees' understanding of actual ships' data. The appendix to this instructor manual contains stability data and capacity tables for use in the preparation of exercises. Instructors should make a collection of data for other ships as the opportunity arises. The application of the principles of stability to determining the final draught, trim and initial GM for a given complete distribution of cargo is included in the function, Cargo Handling and Stowage.

Approximate calculation of areas and volumes

This section covers the use of the trapezoidal rule and Simpson's rules for the calculation of areas. The derivation of Simpson's rules and their use for finding moments or second moments of area has not been included. The calculation of volume where the given ordinates are areas is covered.

The use of Simpson's rules is required for finding areas under a GZ curve, for checking compliance with recommendations on intact stability. Trainees should also be able to apply them for calculating areas of decks and volumes of compartments aboard ship.

Effects of density

In tidal estuaries the density of the water may vary considerably according to the state of the tide. When checking draughts or freeboard near completion of loading it is essential to check the density at the same time: using a density obtained earlier in the day could lead to appreciable error.

The term 'inertia' and the abbreviation 'I' are used in keeping with common practice. They may also appear in a ship's hydrostatic data. Strictly, it is the transverse second moment of area of the tank which is involved. Trainees should understand the concept of second moments of area but the method of determining them in general is not required. The formula for a rectangular surface should be known.

Stability at moderate and large angles of heel

The equation $BM = \frac{I}{V}$ has been quoted partly to show that the BM is a function of the ship's dimensions and state of loading and partly to explain the typical behaviour of KM as the draught is increased from light ship conditions. Use is also made of the equation in the treatment of damage stability. The proof of the equation is not required.

GZ curves will normally be constructed from KN curves, but trainees should be able to correct a GZ curve when the value of KG differs from that used in drawing the curve, either by drawing a new curve or by superimposing the curve of GG_1sin (angle of heel) on the original. The initial GM should be used as an aid to constructing the curve at small angles of heel. Trainees should not be expected to deduce the GM from a given curve.

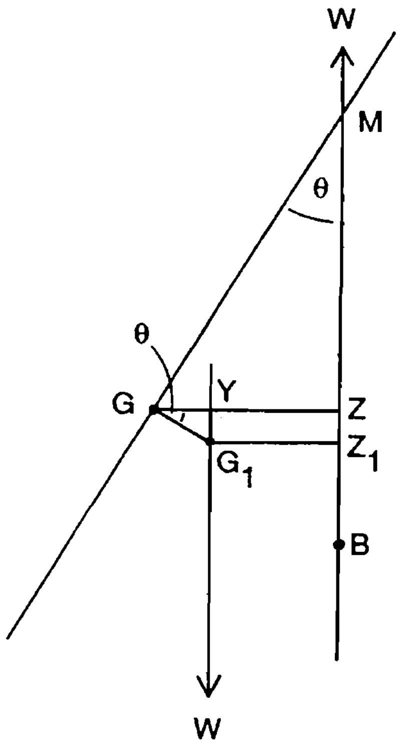


Figure 1

Figure 1 shows a ship with its centre of gravity, G_1, at a distance GG_1 horizontally from the centreline. When inclined to an angle θ, the righting lever is G_1Z_1.

$$G_1Z_1 = GZ - GY$$
$$= GZ - GG_1 \cos\theta$$

The values of GZ derived from KN curves can be reduced to $GG_1 \cos\theta$ before plotting or the curve $GG_1 \cos\theta$ can be superimposed on the GZ curve, as shown in Figure 2.

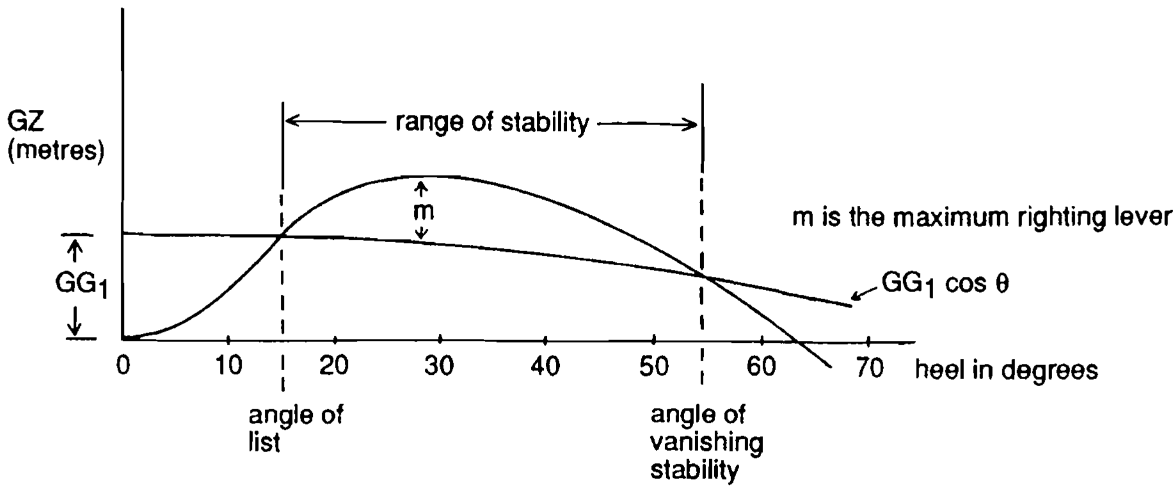


Figure 2

A list reduces the righting levers and the range of stability when heeled towards the listed side. When heeled in the opposite direction, righting levers are increased.

Simplified stability data

Simplified stability data were originally intended for use in small ships, but data in that form may also be found in some larger ships. Each of the several different presentations shows the ship's stability as adequate or inadequate to meet the recommended criteria for intact stability for passenger and cargo ships under 100 metres in length or, in the case of larger ships, the criteria laid down by the Administration.

Data necessary to maintain sufficient intact stability under service conditions to enable the ship to withstand the critical damage assumptions of SOLAS would be provided in passenger ships.

Trim and list

Trim calculations using moments about the centre of flotation or trimming tables were covered in IMO Model Course, Officer in Charge of a Navigational Watch. These methods are suitable only in cases where the change in displacement is sufficiently small so that there are no large changes in the position of the centre of flotation or the value of MCT. When large changes in displacement are involved, as, for example, in planning the loading of a ship, the following method should be used.

Figure 3 shows a ship on a even keel with longitudinal centres of buoyancy and gravity indicated. The weight and buoyancy forces form a couple, called the trimming moment, equal to the product of the displacement and the horizontal separation between B and G, in this case acting to trim the ship by the stern. The ship will trim until the centre of buoyancy of the new underwater volume is in the same vertical line as G, which is fixed.

The trim is given by $\frac{\text{trimming moment}}{\text{MCT 1cm}}$ where the MCT is taken for the displacement of the ship.

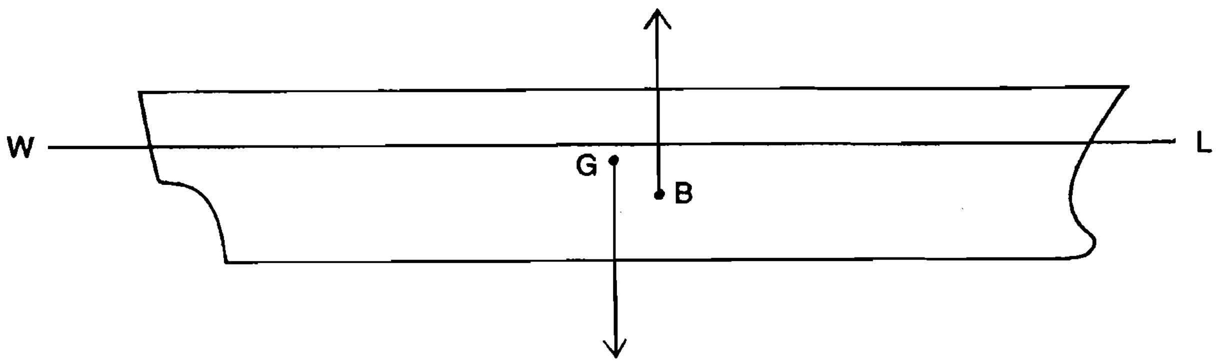


Figure 3

The position of the longitudinal centre of buoyancy (LCB), for an even-keel condition, depends upon the ship's draught and is given in the hydrostatic data as a distance, either from the after perpendicular or from amidships.

The position of the longitudinal centre of gravity is found by taking moments of mass, about the after perpendicular or about amidships, of the light ship and all of its contents. The LCG for the light ship is included in the hydrostatic data. LCG's of tanks and holds are given in the capacity plans or can be measured from the profile plan.

To find the draughts at each end, the trim is divided in the usual way, according to the proportionate distances of the perpendiculars from the centre of flotation, and applied to the ship's true mean draught.

When a ship is hogged or sagged there is a difference between the mean draught calculated from the draughts at the ends and the draught amidships. The difference is the amount of hog or sag. Taking the case of a ship with a sag, the draught amidships is greater than the mean draught. The ship's displacement lies between the values obtained for the two draughts and corresponds to some intermediate draught.

A weighted average of the mean draught and draught amidships is used. The commonly used values are:

corrected draught = ¾ x draught amidships + ¼ x mean draught;
or corrected draught = ⅔ x draught amidships + ⅓ x mean draught.

These amount to applying ¼, in the first case, or ⅓, in the other, of the hog or sag to the amidships draught.

A method known as the mean of mean of means is sometimes used. The mean of the forward and after draughts is found, the mean of that and the draught amidships is found and the mean of that with the draught amidships again gives the required draught. The result is the same as for the first equation above.

Nemoto's formula
When utmost accuracy is required, as in draught surveys for quantity loaded or discharged, a second correction for trim, using Nemoto's formula, may be applied to the displacement. It is usually only applied when the trim exceeds 1% of the ship's length.

$$\text{correction (tonnes)} = \frac{t^2 x 50}{L} \times \frac{dM}{dZ}$$

where: t is the trim in metres
L is the length between perpendiculars in metres
d is the mean draught

$$\frac{dM}{dZ} = \text{MCT 1cm at (d + 0.5)m} - \text{MCT 1cm at (d-0.5)m}$$

The correction is always added to the displacement.

Dynamical stability
In calculating the area under a GZ curve to a given angle, using Simpson's rules, the interval between ordinates may be expressed in degrees.

The calculated area would be expressed in metre-degrees, which can be converted to metre-radians, if required, by dividing by 57.3. The dynamical stability is the area under the curve in metre-radians multiplied by the ship's displacement in tonnes. The result is expressed in metre-tonnes, the radians being omitted since they are dimensionless. Usually, it is areas under the GZ curve which are required for checking stability criteria which, depending upon the ship's data, may be expressed in metre-degrees or metre-radians.

The area under the GZ curve to a given angle represents not only the work done in heeling the ship to that angle but also the potential energy available to return the ship to the upright. By the principle of conservation of energy, the potential energy is converted into rotational energy as the ship moves towards the upright. When upright, all of the energy is in the form of rotational energy, so the ship continues to roll until an angle is reached where the area under the curve is equal to that rotational energy. The energy used in overcoming friction between hull and water and in creating turbulence reduces the angle to which the ship will roll.

The wind exerts a horizontal force on the above-water area of the ship and deck cargo which can be considered to act at the centre of the projected area. That force is resisted by the water acting on the underwater area on the other side, usually considered to act at about half the draught. The two forces form a couple inclining the ship until the righting moment is equal to the inclining couple. In the Recommendation on a Severe Wind and Rolling Criterion for the Intact Stability of Passenger and Cargo Ships of 24 metres in Length and Over, no allowance is made for a reduction in the projected lateral area or the vertical separation between the centres of areas, above and below the waterline, as the ship heels. The wind pressure used in the recommendation corresponds approximately to storm force 10 on the Beaufort scale.

List should always be removed before sailing and cargo should be adequately secured to prevent a shift producing a listed condition while on passage.

Approximate GM by means of rolling tests
The method is described in appendix III of the Recommendation on Intact Stability for Passenger and Cargo Ships under 100 metres in Length, in reference R6.

Inclining test
The purpose of the inclining test is to determine the displacement and position of the ship's centre of gravity in an accurately known condition. It is usually carried out when the ship is as nearly complete as possible, small corrections being made for any components still to be fitted or shipyard stores aboard at the time to obtain values for the light ship condition.

The draughts and water density are carefully measured for use with the ship's lines plan to calculate the displacement, the height of the transverse metacentre above the base (KM) and the position of the longitudinal centre of buoyancy.

The test consists of moving weights across the deck under controlled conditions and measuring the resultant angle of list. The angles are deliberately kept small and are measured by long pendulums suspended down holds or engine-room skylights.

The mean value of GM calculated from the deflections is subtracted from the KM to give the vertical height of the centre of gravity. Since the centre of gravity and centre of buoyancy are in the same vertical line for a ship in equilibrium, the position of the LCG can be calculated from the previously determined LCB.

Recommendations on intact stability for passenger and cargo ships under 100 metres in length
The recommendations are contained in R6. Instructors should refer to the stability requirements of the Administration for ships of 100 metres in length and over.

Intact stability requirements for the carriage of grain
The SOLAS Convention deals with the carriage of grain. The intact stability requirements are laid down, and the loading information required for determining the stability. The method of calculating intact stability is illustrated.

Rolling of ships
A mathematical treatment of rolling is not required. Trainees should know that the natural rolling period is inversely proportional to the square root of the GM. Rolling in a seaway is a forced oscillation, the period depending upon the period of encounter of the waves or swell as well as the natural rolling period. when the period of wave encounter equals the natural rolling period, synchronization occurs. Very heavy rolling can be induced by a moderate sea. An alteration of course or speed, or both, changes the encounter period of the sea and breaks the synchronization.

The equation in this objective produces a result in force units (kilonewtons in this case), hence the balancing heeling couple must be expressed in the same units in the equation in the objective relating to the righting moment equalling the heeling couple, by multiplying the usual mass moment by g, the acceleration due to gravity.

In the unusual event of the centre of gravity falling below half draught the heel would be towards the turn.

In the unusual event of the centre of gravity falling below half draught the heel would be towards the turn.

Dry-docking and grounding
When dealing with stability during dry-docking, it is simplest to consider the righting moment when heeled by taking moments about the centre of buoyancy, which produces the equation:

$$\text{righting moment} = \Delta \times GM \sin\theta - P \times KM \sin\theta$$

directly.

The righting lever, GZ, is given by the equation:

$$GZ = \left(GM - \frac{P \times KM}{\Delta}\right) \sin\theta,$$

which is the righting lever for the ship with its GM reduced by $\frac{P \times KM}{\Delta}$.

By making use of KM = KG ÷ GM, the alternative expression for righting lever can be obtained. This approach has the advantage of showing that, although different values of GM are obtained, the value of the righting moment is the same in each case. The value of P for which GM – 0 is also the same for both expressions.

The stability of a ship grounded at a point on the centreline is treated in exactly the same way as the dry-docking problem. A ship grounded forward, say, on a falling tide, would experience a reducing righting lever and the point could be reached at which it became zero. Providing the ship did not touch bottom elsewhere, it would flop over to an angle of loll or possibly capsize.

When grounded at a point off the centreline, a heeling moment is also produced. Considering the case where only heeling moment is involved, at the point of capsize the upthrust from the bottom becomes zero, therefore the ship would not capsize until heeled to its angle of vanishing stability when afloat. In most circumstances, cargo would have shifted, water entered through non-watertight openings or the ship would have slid off before reaching that angle. When the grounding force causes trim as well as heel the angle of vanishing stability may be much smaller.

It should be recalled that buoyancy is provided by the vertical component of water pressure on the ship's hull. When a ship is grounded on firm sand or a bottom of similar nature, water is unable to exert any pressure on the grounded portion and there is a loss of buoyancy compensated by an increased upthrust from the ground. If a ship is grounded over the whole of its bottom there is a large loss of buoyancy for any drop in water level, however small. Stability is not a problem in that circumstance but the fact that nearly all the weight of the ship is supported by the ground must be considered when deciding how to refloat her.

3.1.2 EFFECT ON TRIM AND STABILITY IN THE EVENT OF DAMAGE AND FLOODING

The methods of calculating transverse stability, list and trim in a damaged condition are based upon the principles used in the textbook T2, but the problem has been approached in a way more applicable to the use of a ship's hydrostatic data, although still confined to compartments with roughly rectangular waterplanes.

Flooding of compartments

The requirements for the watertight subdivision of passenger ships are set out in SOLAS. Depending upon the type of service and its size, the ship will be required to withstand the flooding of one, two or three adjacent main compartments.

The International Convention on Load Lines, lays down requirements for the survivability of ships of type 'A', if over 150 metres in length, and for ships of type 'B' which are over 100 metres in length and are assigned freeboards less than the tabular freeboards for type 'B' ships.

Classification society rules stipulate the minimum number of bulkheads to be fitted in dry cargo ships, depending upon length, but do not specify that they should be fitted in such a way that the ship could withstand flooding of a main compartment.

Proposed amendments to the SOLAS Convention will provide regulations governing the subdivision and damage stability of cargo ships. They will apply to ships over 100 metres in length intended primarily for the carriage of dry cargoes, but will exclude those ships already covered by other damage stability regulations in IMO instruments.

The proposed regulations are based on consideration of the probability of the location and extent of damage and the probability of survival after damage. The probabilities of survival conditional upon each possible damage configuration for compartments, singly or in adjacent groups, are summed for the summer draught and for a draught intermediate between light and loaded. The average of the two sums gives a value known as the "attained subdivision index, A" which must not be less than the "required subdivision index, R", which is a function of the length.

Effect of flooding on transverse stability
When a space is flooded without free communication with the sea, the stability can be calculated by taking account of the mass of water and the free surface effect. Examples would be the accumulation of water in 'tween-decks as a result of fire fighting, or flooding through a crack in the hull or through a fractured pipe. The ship's hydrostatic data for the increased displacement are applicable for the calculations.

If a compartment is holed so that water can flow freely in and out of it, that compartment can be considered as part of the sea and no longer part of the ship. The buoyancy of the space up to the water level before damage is lost and the waterplane area of the ship is reduced by the waterplane area of the damaged compartment. These changes give rise to changes in the hydrostatic data needed to calculate the transverse stability and trim. The mass of the ship and its centre of gravity remain unaltered. Such a treatment is known as the 'lost buoyancy method' and is the one used in this course and in the textbook T11.

The lost buoyancy, expressed in tonnes, is the mass of water which could enter the space up to the original waterplane, i.e. the volume x permeability x density of water in which the ship is floating.

The lost waterplane area is the area of the bilged compartment at the original waterplane. If the compartment is completely contained below the waterline, e.g. a double-bottom tank, there is no loss of waterplane area provided the tank top remains intact. The original waterplane area may be given in the ship's data or it can be calculated from

$$\text{waterplane area} = \frac{100 \times \text{TPC}}{1.025}$$

Of the two corrections in this objective, the first is the second moment of lost waterplane area about its own centroid, the second a correction to give the loss about the new centroid of the intact waterplane. In the case of symmetrical flooding, the second correction is zero. For wing compartments, the second correction is very much greater than the first, even for compartments extending half the breadth of the ship.

Generally, the displacement of the ship and the position of the centre of gravity will remain unchanged after bilging. However, if a tank containing a liquid is bilged, the weight of the tank contents is lost, causing a reduction in displacement and a shift in the position of the ship's centre of gravity. The lost buoyancy would be comparable with the lost weight, causing a similar shift in the centre of buoyancy with the result that there would be little change of draught, trim or list. The loss of waterplane area would result in a reduction of GM.

Permeability
The permeability of a space is the percentage or fraction of the space which could be occupied by water. The lost buoyancy equals the permeability x the volume. If a cargo was stowed solidly, with no space for water in infiltrate, it would occupy $\dfrac{1}{density}\, m^3/t$

The space occupied in the hold by one tonne is its stowage factor, so the space available to water = stowage factor – $\dfrac{1}{density} m^3/t$

The proportion of the stow which could be occupied by water, i.e. the permeability, equals

$$\frac{\text{stowage factor} - \dfrac{1}{density}}{\text{stowage factor}}$$

For example, a cargo has a stowage factor of 1.2 m^3/t and a density of 2.5 t/m^3.

$$\frac{1}{density} = \frac{1}{2.5} = 0.4 m^3/t$$

$$permeability = \frac{1.2 - 0.4}{1.2} = \frac{0.8}{1.2} = 0.67$$

Notice, if a cargo has a permeability of 0.4 but only occupies half of the compartment, the permeability of the whole compartment is 0.4 x 0.5 + 0.5 = 0.7.

The loss of waterplane area is taken to be permeability x waterplane area of the compartment, but if the water level is above the top of the cargo the whole area is lost.

Angle of heel

Buoyancy is lost at the damaged compartment and an equal amount of buoyancy is gained at the position of the new centre of flotation. The transverse shift in the ship's centre of buoyancy is, therefore, lost buoyancy x transverse distance from centre of flotation divided by the displacement. On the assumption that the centre of gravity is still on the centreline, the shift in buoyancy is the heeling arm.

The angle of heel would be given by the intersection of the GZ curve for the damaged ship with the heeling-arm curve $BB_1 \cos \theta$. Since KN curves for the damaged condition are not available, the GZ curve has to be constructed, using values for the intact ship at a displacement corresponding to the damaged draught and a KG chosen to give the modified value of GM. The angle of heel read from the curve will be approximate. If the angle is small it can be calculated from, $\tan \theta = \dfrac{BB_1}{GM}$

Effect of flooding on trim

Similar calculations are necessary to find the longitudinal position of the centre of flotation after damage, and the reduction of BM_L. The change in GM_L is used to calculate the change in MCT 1cm.

Buoyancy has been lost at the damaged compartment and replaced at the centre of flotation, hence the trimming moment is the product of lost buoyancy and the distance from the centre of the damaged compartment to the new centre of flotation. The change of trim and the draught at each end are then calculated in the usual way.

Flooding of a compartment near an end of the ship causes a large shift in the centre of flotation away from the damaged end and a large reduction in MCT 1cm. Combined with the sinkage due to lost buoyancy, this may produce a large increase in draught at the damaged end. The original trim of the ship will influence the chances of the ship surviving the damage.

A ship already trimmed towards the damaged end is more vulnerable than one on an even keel or trimmed the other way.

Measures to improve stability or trim when damaged
The immediate action should be to restrict the flooding and, if possible, to stop it. In the event of collision or stranding damage, it will not be possible to stop the flooding or reduce it significantly by the use of pumps. Even a comparatively small hole below the waterline admits water at a much higher rate than the capacity of bilge or ballast pumps. All watertight doors, valves, dampers in ventilation shafts and access hatches should be closed to prevent flooding progressing to other compartments. Where cross-flooding arrangements are required, they should be put into operation at once to restrict the resulting list.

In passenger ships, the guidance in the damage control booklet should be followed. The same applies to cargo ships where damage control information is provided.

In nearly all cases, damage will result in sinkage, list and trim, loss of stability and loss of longitudinal strength. Corrective action for one condition will affect the others.

Excessive list or trim should be corrected by moving weights, fuel, water or liquid cargoes, when possible. If ballast is added, it increases the sinkage. In some cases it may be possible to pump out ballast to improve list or trim and lighten the ship at the same time. If the ballast is taken from double-bottom tanks, however, the stability will be further reduced.

Stability may be improved by transferring fuel from wing or cross bunker tanks to double bottoms if suitable tanks are empty. Efforts should be made to reduce free surface to a minimum. Water accumulating in upper decks as a result of fire fighting should be drained to the lowest level possible if means of pumping it out of the ship cannot be arranged.

After collision or stranding damage, particularly near the middle length of the ship, the longitudinal strength will be impaired and account should be taken of that when deciding on the transfer or addition of weights.

Cases have occurred where a slow leakage of water has been absorbed by a cargo, such as grain, with no water reaching the drain wells. The added weight, high on one side of the hold, has led to a steadily increasing list and eventual capsizing. As the source of the leakage was inaccessible, nothing could be done. Cargo spaces should be thoroughly inspected whenever they are empty for signs of leakage, indicating cracks or damage to overside discharge valve covers.

3.1.3 KNOWLEDGE OF IMO RECOMMENDATIONS CONCERNING SHIP STABILITY
Instructors should refer to the IMO publications referenced in the detailed teaching syllabus.

3.2 Monitor and Control Compliance with Legislative Requirements and Measures to Ensure Safety of Life at Sea and the Protection of the Marine Environment

3.2.1 INTERNATIONAL MARITIME LAW EMBODIED IN INTERNATIONAL CONVENTIONS

This area covers those international conventions, regulations and recommendations which directly affect the master in carrying out his obligations and responsibilities.

Those parts of the Geneva Conventions on Law of the Sea of 1958 and the United Nations Convention on the Law of the Sea, 1982, which are relevant to the conduct of a voyage have already been covered at the operational level. Some brief revision may be necessary with an emphasis placed on the master's legal obligations concerning the requirements for certificates and other documentation, the survey requirements, the provision for inspections by the master or an officer delegated by him, the maintenance of equipment and the records that are required to be kept.

The technical details, where appropriate, are mainly dealt with under other relevant subjects. The International Regulations for Preventing Collisions at Sea are covered entirely in the function Navigation.

We also deal with the necessary basic knowledge of law concerning carriage of cargo and marine insurance. Those subjects, together with a few others, are supplementary to the STCW 1995 requirements and are indicated as such below and in the Detailed Teaching Syllabus in Part C with an asterisk, *.

Instructors should note that the following areas are covered in the training at the operational level. Some areas are covered again with emphasis on the master's responsibilities.

1. An introduction to Maritime Law
2. Law of the Sea
    - 2.1 Conventions on the law of the sea
    - 2.2 Territorial sea and the contiguous zone
    - 2.3 International straits
    - 2.4 Exclusive economic zone and the continental shelf
    - 2.5 High seas
    - 2.6 Protection and preservation of the marine environment
3. Safety
    - 3.1 International Convention on Load Lines, 1966, as amended
    - 3.2 International Convention for the Safety of Life at Sea, 974, as amended (SOLAS) – General Provisions
    - 3.3 SOLAS – Subdivision and stability, machinery and electrical installations
    - 3.4 SOLAS – Fire protection, fire detection and fire extinction
    - 3.5 SOLAS – Life-saving appliances and arrangements
    - 3.6 SOLAS – Radiotelegraphy and radiotelephony
    - 3.7 SOLAS – Radiocommunications (amended Chapter IV)
    - 3.8 SOLAS – Safety of navigation
    - 3.9 SOLAS – Carriage of grain
    - 3.10 SOLAS – Carriage of dangerous goods
    - 3.11 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978
    - 3.12 ITU Radio Regulations

4. Passengers
   4.1 Special Trade Passenger Ships Agreement and Rules, 1971
   4.2 Protocol and Rules on Space Requirements for Special Trade Passenger Ships, 1973
   4.3 Athens Convention relating to the Carriage of Passengers and their Luggage by Sea, 1974

1.1 Certificates and Other Documents Required to be Carried on Board Ships by International Conventions and Agreements

The master must be familiar with all the certificates and other documents required by the vessel and by the crew. These will be subject to inspection by both the flag state and by port State control officers. Documents found not to be in order can cause delays on detentions to the voyage.

Relatively new requirements include the Safety Management Certificate denoting that the company and its shipboard management operate in accordance with the approved safety-management system. A copy of the Document of compliance shall also be kept on board the ship in order that the master can produce it for verification.

Instructors may note that SOLAS Annex 3, (R2) contains a list of the certificates and documents required to be carried on board ships.

In Section C the certificates are listed for convenience of reference. The requirements for their issue and renewal are dealt with under the appropriate conventions, except for those mentioned below.

A certificate of nationality, often called the ship's register, is required by the Geneva Convention on the High Seas, 1958, and by the UNCLOS, 1982. The form of certificate and the conditions for its issue are determined by each national government. In some cases it remains valid until the ship is scrapped or changes ownership or nationality, in others it is subject to regular renewal.

The Panama and Suez Canal Tonnage Certificates are included for completeness; they are not required by international conventions. Any ship wishing to traverse either canal must be measured and obtain the appropriate certificate before doing so. In general, they remain valid until alterations to the ship's structure or in the use of spaces are made.

Tonnage

The International Tonnage Certificate remains valid until alterations in construction or the use of spaces are made, the subdivision load line is changed or the ship is transferred to the flag of another State.

The licence for the ship radio station is required by the radio regulations of the ITU. The form of the licence is determined by the national government which issues it.

There are no international agreements requiring a ship to be classed by a classification society, but practically all ships are. Loss of class would be an indication to a port State control officer that a thorough inspection of the ship should be made. Maintenance of class is a condition for the continuance of insurance in many cases.
The form of the official log-book, the entries made in it and its eventual disposal are decided by each Administration.

The documents listed as a minimum additional documents required at arrival or departure are those mentioned in the Convention on Facilitation of international traffic, the international health regulations and the dangerous goods manifest required by SOLAS.

1.2 Responsibilities under the Relevant Requirements of the International Convention on Load Lines

Instructors should note that the Load Lines Protocol of 1988 will enter into force on 3 February 2000.

1.3 Responsibilities under the Relevant Requirements of the International Convention for the Safety of Life at Sea

Of all the international conventions dealing with maritime safety the most important is the International Convention for the Safety of Life at Sea, better known as SOLAS which covers a wide range of measures designed to improve the safety of shipping.

The convention is also one of the oldest of its kind: the first version was adopted in 1914 following the sinking of the SS Titanic with the loss of more than 1,500 lives. Since then there have been four more versions of SOLAS. The present version was adopted in 1974 and entered into force in 1980. Some recent additions are covered in V8 and the 1996 Amendments in R2.

Reference should be made to the International Safety Management (ISM) Code in Chapter IX, which sets out the master's responsibility with regard to safety and environmental protection, see V8 and V14.

1.4 Responsibilities under the International Convention for the Prevention of Pollution from Ships, 1973, and the Protocol of 1978 relating thereto (MARPOL 73/78)

Relatively new additions to maritime law should be noted including MARPOL 73/78 Annex 1, regulation 26 that requires every oil tanker of 150gt and above and every ship other than a tanker of 400gt and above to have a shipboard oil pollution emergency plan (a SOPEP), and amendments to MARPOL Annex V that require garbage management plans to be in place.

Under Annex IV ships are not permitted to discharge sewage within four miles of the nearest land, unless they have in operation an approved treatment plant. Between 4 and 12 miles from land, sewage must be comminuted and disinfected before discharge.

Annex VI, when it comes into force, will set limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibit deliberate emissions of ozone-depleting substances.

Pollution

Tanker officers who have had responsibility for loading, discharging and handling cargo will have completed an approved specialized training programme. This includes instruction in pollution prevention relevant to tankers, V1, V2.

Examples of checklists can be found in the references. More extensive checklists are used at many oil installations and include, amongst other things, a list of equipment on board and ashore, whether it is fully operational or not, the communications to be used and emergency procedures. The completed checklists are signed by the responsible persons from the ship and the installation when it is agreed to start the operation.

It is recommended that, whenever possible, disposal of garbage should be made to port facilities. Disposal at sea is strictly regulated by the provisions of the appropriate legislation. Records of waste and garbage disposed of at sea must be kept. These records are subject to inspection and checking by port State control officers.

The annexes to the Convention contain the applicable technical regulations. These are:

Annex I – Oil
Annex II – Noxious liquid substances in bulk
Annex III – Harmful substances carried by sea in packaged forms
Annex IV – Pollution by sewage from ships
Annex V – Pollution by garbage from ships
Annex VI – Air pollution from ships and NO_x technical code

1.5 Maritime Declarations of Health and the Requirements of the International Health Regulations

Arrival Documents and Procedures: these are all very practical requirements that have to be followed.

Officers should be aware that many states will require forms and declarations in addition to those mentioned in the FAL and in the International Health Regulations. The ship's agents should be consulted for the current requirements at any port.

Noting protests: the need to note or extend protests varies from country to country. In many countries it is essential to do so to protect the interests of the ship. For example, failure to do so could debar the master from collecting general average contributions from the cargo. The owner's agent should be able to advise the master regarding the procedure and the number of crew members required as witnesses, if any.

1.6 Responsibilities under International Instruments affecting the Safety of the Ship, Passengers, Crew and Cargo

Maritime Labour Conventions and Recommendations covered here include the following. This is an extensive list, but increasingly crew conditions of service and accommodation are coming under scrutiny and these areas are covered in the following legislation.

Those areas supplementary to the STCW 1995 requirements and are indicated as such below with an asterisk, *

Convention concerning Minimum Standards in Merchant Ships, 1976 (No. 147)
* Convention concerning Seamen's Articles of Agreement, 1926 (No. 22)
Convention Fixing the Minimum Age for the Admission of Children to Employment at Sea (Revised 1936) (No. 58)
Convention concerning Minimum Age for Admission to Employment , 1973 (No. 138)
Convention concerning Certification of Ships' Cooks, 1946 (No. 69)
* Convention concerning the Certification of Able Seamen, 1946 (No. 74)
Recommendation concerning Vocational Training of Seafarers (Recommendation No. 137)
Convention concerning Wages, Hours of Work on Board Ship and Manning (Revised 1958) (No. 109)
* Convention concerning Vacation Holidays with Pay for Seafarers (Revised 1949) (No. 91)

* Convention concerning Annual Leave with Pay for Seafarers, 1976 (No. 146)
* Convention concerning the Repatriation of Seamen, 1926 (No. 23)
* Convention concerning the Repatriation of Seafarers (Revised), 1987 (No. 166)
• Recommendations concerning the Repatriation of Seafarers (Recommendation No. 174)
* Convention concerning Food and Catering for Crews on Board Ship, 1946 (No. 68)
* Convention concerning Crew Accommodation on Board Ship (Revised 1949) (No. 92)
* Convention concerning Crew Accommodation on Board Ship (Supplementary Provisions), 1970 (No. 133)

Recommendations concerning the contents of Medicine Chests on Board Ship (Recommendation No. 105)

Convention concerning the Prevention of Occupational Accidents to Seafarers, 1970 (No. 134)

Recommendation concerning the Prevention of Occupational Accidents to Seafarers, 1970 (Recommendation No. 142)

Convention concerning the Compulsory Medical Examination of Children and Young Persons Employed at Sea, 1921 (No. 16)

Convention concerning the Medical Examination of Seafarers, 1946 (No. 73)

Convention concerning Health Protection and Medical Care for Seafarers, 1987 (No. 164)

* Convention concerning the Liability of the Shipowner in Case of Sickness, Injury or Death of Seamen, 1936 (No. 55)
* Convention concerning Sickness Insurance for Seamen, 1936 (No. 56)
* Convention concerning Social Security for Seafarers (Revised), 1987 (No. 165)
* Convention concerning Seafarers' Welfare at Sea and in Port, 1987 (No. 163)
* Recommendation concerning Seafarers' Welfare at Sea and in Port (Recommendation No. 173)
* Convention concerning Freedom of Association and Protection of the Right to Organise, 1948 (No. 87)
* Convention concerning the Application of the Principles of the Right to Organise and to Bargain Collectively, 1949 (No. 98)
• Convention on Limitation of Liability for Maritime Claims, 1976 (LMC 1976)

Classification Societies

* Cargo

    International Convention for the Unification of Certain Rules of Law Relating to Bills of Loading, as Amended by the Protocol of 1968 (Hague-Visby rules)

    Charter Parties

* Hamburg Rules
* General Average and Marine Insurance

    The York-Antwerp Rules, 1974

    Marine Insurance

In covering the ILO Labour Conventions and recommendations, the relevant national laws and regulations or collective bargaining agreements, where applicable, should be dealt with . The administrative procedures involved, e.g. the correct procedures for signing off a sick seaman abroad, the disposal of a deserter's wages and effects or the engagement of replacements abroad and similar procedural matters, should be included in detail. Reference should also be made to arrangements to safeguard the shipmaster in the proper discharge of his responsibilities in regard to maritime safety and protection of the marine environment, as recommended in Assembly resolution A.443(XI), R39.

Convention No. 147, Merchant Shipping (Minimum Standards), brings together the standards laid down in the list of conventions, concerning employment and social aspects of maritime labour, which appear in the appendix to the Convention. The appendix also includes conventions on freedom of association, the right to organize and collective bargaining.

Convention 147 requires States ratifying it either to have ratified the conventions in the appendix or to have national legislation substantially equivalent to them.

The IMO/ILO Document for Guidance, 1985, contains recommendations for training leading to the qualification for an able seaman certificate in Section 26.

The International Medical Guide for Ships (IMGS), 2nd edition (Geneva, World Health Organization, 1987) is designed to meet the requirements of paragraph 3 of the recommendation. The Guide was prepared jointly by ILO and WHO. Chapters 17, 18 and 19 of the Guide contain recommendations on the contents of ships' medicine chests.

Chapter 14 of the IMGS contains a checklist of information to be prepared before calling for medical advice by radio.

Reference should be made to the ILO Code of Practice Accident prevention on board ship at sea and in port and to any relevant national code of safe working practice, for example see T70.

Collision

The master's responsibilities under the Convention on the International Regulations for Preventing Collisions at Sea, 1972, are fully covered in the function, Navigation at the Management Level

Assistance and Salvage

At the request of IMO, the CMI drew up a new draft convention on salvage at Montreal in 1981 to update and revise the 1910 convention. The main new features relate to damage to the environment.

Masters and shipowners would have a duty to arrange salvage assistance and to co-operate with the salvors to prevent or minimize damage to the environment.

The draft Convention also made provision for special compensation to a salvor in cases where the salvor has carried out salvage operations in respect of a ship or cargo which threatened the environment but has failed to earn a reward for physical salvage. The International Convention on Salvage, 1989, was adopted by a diplomatic conference in March 1989 and entered into force on 14 July 1996.

Lloyd's Standard Form of Salvage Agreement (LOF) is widely used throughout the world. LOF 1990 takes account of the main changes included in the 1989 Salvage Convention and incorporates certain of the Convention Articles, including Article 14, which makes provision for the award of special compensation in cases where the salvor, by his salvage operations, has prevented or minimized damage to the environment. Since a large proportion of the world's salvage is undertaken under the LOF, the use of LOF 1990 will give effect to the main provisions of the 1989 Salvage Convention, see Appendix.

Proceedings in the event of a collision
Instructors should explain that in the event of a collision or of any other incident of navigation concerning a ship on the high seas involving the penal or responsibility of the master or of any other person in the service of the ship, no penal or disciplinary proceedings may be instituted against such persons except before the judicial or the administrative authorities either of the flag State or of the State of which such a person is a national.

Need to render assistance
Also that every State must require the master of a ship sailing under its flag, in so far as he can do so without serious danger to the ship, the crew or the passengers, to render assistance to any person found at sea in danger of being lost, to proceed with all possible speed to the rescue of persons in distress if informed of their need of assistance, in so far as such action may be reasonably expected of him, and, after a collision, to render assistance to the other ship, her crew and her passengers and, where possible, to inform the other ship of the name of his own ship, her port of registry and the nearest port at which she will call.

Submarine cables
In the event that a ship breaks or injures a submarine cable so as to interrupt or obstruct telegraphic or telephonic communications, or similarly the breaks or injures submarine pipeline or high-voltage power cable it must be understood that this is, except for the purpose of saving lives or ships, a punishable offence.

However, owners of ships who can prove that they have sacrificed an anchor, a net or any other fishing gear in order to avoid injuring a submarine cable or pipeline should be indemnified by the owner of the cable or pipeline, provided that the owner has taken all reasonable precautionary measures beforehand.

*** Convention on Limitation of Liability for Maritime Claims, 1976 (LLMC 1976)**
The LLMC Convention sets global limits to liability. For example, the limit in respect of death or injury of passengers in Article 7 is the global limit for all claims. Each individual claim is subject to the limitation in the Athens Convention.

Classification Societies
Classification societies are independent, normally non-commercial organizations. They were originally established to designate minimum standards on which underwriters could rely before insuring a vessel but have, over the years of their existence, developed into standard-setting institutions for every section of the shipping community. Through their rules for construction and a regime of periodical surveys they are in a position to enhance ship construction and operation. They supervise all stages of the construction or major repairs of a ship, even to the extent of ensuring that the right materials are used. A ship so constructed is assigned a class in accordance with some code.

In order to retain its class, the vessel must be presented for survey at periodical intervals as specified in the rules. Failure to meet these terms or to comply with recommendations issued may result in the suspension or cancellation of its class.

Although it is not a legal requirement to be classed, practically all ships are. It is usually a condition for marine insurance or a maritime mortgage that the ship is classed and is maintained so as to retain her class.

The large classification societies have surveyors stationed a the major ports round the world who, in addition to classification work, carry out statutory surveys required by international conventions under authority delegated to them by national maritime Administrations.

*** Cargo**

A brief description of the use of documentary credit has been included to show how the bill of lading is involved as security for the sale of goods and how important it is that the description of the goods shown in the bill of lading is correct.

*** 'Hamburg Rules' Maritime Legislation**

*** General Average and Marine Insurance**

The role of the York-Antwerp Rules in the adjustment of general average is covered in the Marine Claims Handbook, see below. The rules are also included.

Non-disclosure does not include circumstances which the shipowner could not know about. However, it has been held that non-disclosure of circumstances which should have been known but were not, possibly due to the master's failure to keep the owner informed, would be grounds for the insurer to avoid the insurance contract.

The "duty of assured" clause is intended to encourage the assured to take all reasonable measures to avert or minimize the damage or loss which will form a claim on the policy. Claims under this clause are treated separately from others and are payable in addition to other claims, even in the event of total loss. It is said that the assured should behave as if uninsured.

Protection and Indemnity Associations and the cover provided by them are dealt with in references below:

Use of maritime transport. A guide for shippers, freight forwarders and ship operators, Volume 2, UN Economic and Social Commission for Asia and the Pacific (ST/ESCAP/516).

Hudson, NG and Allen, JC Marine Claims Handbook 5th ed. London, LLP Limited, 1996 (ISBN 1 85978 048 2).

Aragon, James R., Shipmaster's handbook on ship's business, 2nd ed. (Centreville, Maryland, Cornell Maritime Press, 1988 (ISBN 0-87033-378-X). This book is based on United States laws and regulations but contains much sound general advice for masters on legal matters and procedures.

Hill C., Robertson B., and Hazelwood S.J., An introduction to P&I, 2nd ed. LLP Limited, London, 1996 (ISBN 1-850440883-3).

1.7 Methods and Aids to Prevent Pollution of the Marine Environment by Ships Pollution

This covers the following IMO conventions:

Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention)

International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969

International Convention on Civil Liability for Oil Pollution Damage, 1969

The International Convention for the Prevention of Pollution from Ships, 1973, and the Protocol of 1978 relating thereto (MARPOL 73/78) has been covered earlier.

1.8 National Legislation for Implementing International Agreements and Conventions
Instructors should develop their own objectives here to ensure that national legislation, that is the flag state laws are covered to an extent that meets or exceeds the standards layed down in the international conventions, codes and agreements. Emphasis should be on monitoring compliance, identifying areas where there may be potential for non-compliance or differences compared to international standards.

3.3 Maintain Safety and Security of Crew and Passengers and the Operational Condition of Safety Systems

3.3.1 LIFE-SAVING APPLIANCE REGULATIONS
The requirement of the STCW Convention is covered by IMO Model Course 1.23, Proficiency in Survival Craft and Rescue Boats other than Fast Rescue Boats. Trainees who have successfully completed that course and have been issued with a certificate of proficiency in survival craft have demonstrated the ability and knowledge necessary to satisfy the requirements of the regulations concerning life saving.

The obligations and responsibilities of the master under the requirements of the life-saving appliance regulations of the International Convention for the Safety of Life at Sea, 1974, as amended, are dealt with in the subject, Maritime Law, of this course.

Search and rescue
The syllabus for training in search and rescue is contained in IMO Model Course, Maritime Search and Rescue Co-ordinator Surface Search. That course provides a thorough knowledge and understanding of the IMO Merchant Ship Search and Rescue Manual (MERSAR) and satisfies the requirements of the STCW Convention. The MERSAR manual will be replaced by the International Aeronautical and Maritime Search and Rescue (IAMSAR) manual to be published at the end of 1998. A revised SAR Convention, which will enter into force on 1 January 2000, clarifies the responsibilities of governments and puts greater emphasis on the regional approach and co-ordination between maritime and aeronautical SAR operations.

3.3.4 ACTIONS TO BE TAKEN TO PROTECT AND SAFEGUARD ALL PERSONS ON BOARD IN EMERGENCIES
SOLAS Regulations list the duties related to passengers which must be assigned to members of the crew. These duties would usually be so arranged that each member of the catering staff would be responsible for a group of rooms. A small party would be charged with taking additional supplies to the lifeboats.

Rescue of persons from a vessel in distress or from a wreck
Unless the situation is critical, conditions should be assessed carefully and a plan prepared before initiating Unless the situation is critical, conditions should be assessed carefully and a plan prepared before initiating rescue action. If the survivors are in no immediate danger and existing conditions make rescue hazardous, consider waiting until conditions have improved or until daylight. Try to establish communications with the survivors to obtain information about their condition and to inform them of the intended method of rescue.

Direct transfer of survivors from a wreck to the ship requires nearly calm conditions and, normally, rescue boats or motor lifeboats will be used.

It is unlikely that the disabled ship or wreck will be drifting at the same rate as the rescue ship so, if time permits, it is a good idea to try to get an estimate of their relative drift rates before launching the boats. At the same time, the rescue ship should reconnoitre the area around the wreck to see if there are any obstructions which might hamper the boats.

During the launching of boats, lifelines, lifebuoys, ladders and nets should be ready in case somebody falls overboard or a boat overturns.

Going alongside a wreck may be difficult. On the lee side the approach may be obstructed by wreckage, and if the wreck is drifting quickly the boat will have difficulty getting away from the side. Sea conditions may make it impossible to approach from the weather side and, since the wreck will probably drift faster than the boat, it will be difficult to remain close enough to transfer survivors. An approach from the weather side is the only possibility when the wreck is on fire or releasing toxic fumes, in which case survivors may have to jump into the water to be picked up by the boats.

If weather conditions make the use of boats too hazardous, and it is not possible to wait for conditions to moderate, a liferaft on a stout line may be towed or floated to the wreck or may be hauled out to the wreck after making connection by line-throwing apparatus. The painter fitted to the liferaft is not heavy enough to be used in this manner.

At the rescue ship, preparations for the transfer of survivors include the provision of a boat rope, nets, ladders, lines and crew standing by to assist. The use of a liferaft alongside as a landing stage releases the boat quickly if it is necessary to make several journeys. Survivors who have been in the sea or survival craft for some time may be suffering from cold, fatigue and sea-sickness and be unable to do much to help themselves.

Man-overboard procedures

The standard man-overboard manoeuvres were dealt with in Model Course 7.03, Officer in Charge of a Navigational Watch, see V9.

The standard full-speed man-overboard manoeuvres, such as the Williamson turn, are not possible in very heavy weather. Turning at speed into a heavy see and swell could cause serious damage to the ship. The turn should be made in the safest way possible in the conditions and the ship manoeuvred into a position to windward of the person in the water. The ship will quickly drift down to him. A few fit crew members, wearing immersion suits, lifejackets and lifelines, should be standing by to help the person on board. Use may also be made of the line-throwing apparatus, with a buoyant head, to drift a line to the person in the water. It is essential to keep the person in sight throughout the operation, and this is difficult in a heavy sea and swell, so any crew not otherwise occupied in the rescue should be posted as look-outs.

When a person is reported to the master as missing, it may reasonably be assumed that efforts have already been made to find him. A final call on the public address system should be made and if there is no response the ship should be turned into its wake and a search along the reciprocal course made. At the same time, a through search of the ship should be organized and the time at which the missing person was last seen should be established. The track should be searched back to the position where it is known the person was still on board. An urgency call requesting other ships in the vicinity to keep a look-out for the person should be made.

3.3.5 ACTIONS TO LIMIT DAMAGE AND SALVE THE SHIP FOLLOWING A FIRE, EXPLOSION, COLLISION OR GROUNDING

Means of limiting damage and salving the ship following a fire or explosion

No definite procedures can be laid down as each occurrence will be unique. Trainees should consider the measures which could be taken in a variety of situations, using materials to be found aboard ship.

It is important to keep observation on damaged areas and temporary repairs, to ensure that there is immediate warning of a worsening situation.

Procedure for abandoning ship

A ship should not be abandoned prematurely. It is generally safer to remain aboard a wreck, to await the arrival of assistance, for as long as possible. This is particularly true in severe weather conditions, when abandoning ship is very hazardous and the condition of the crew will deteriorate rapidly in survival craft. Also, in those conditions, craft are likely to become widely dispersed, making rescue more difficult.

When the condition of the ship is such that sinking or breaking up is inevitable, the ship should be abandoned in time to get clear of her before she sinks or before wreckage makes the launching of survival craft dangerous. In the event of fire or explosion or of the release of toxic fumes it may be essential to get clear of the ship as quickly as possible.

Consideration should be given to the method of passing the 'abandon ship' signal. It should be distinctive, so that it is not confused with other signals or instructions which may be given in an emergency. The instruction to abandon ship may have to be given by word of mouth if other communication systems have broken down.

The duties of the emergency party should include provision for the shutting down of any machinery, as required.

3.4 Develop Emergency And Damage Control Plans And Handle Emergency Situations

3.4.1 PREPARATION OF CONTINGENCY PLANS FOR RESPONSE TO EMERGENCIES

Contingency plans for response to emergencies

Given a brief description of a ship and a crew list, trainees should be able to divide the crew into appropriate emergency teams and draw up the muster list and emergency instructions. Instructions should cover general emergency and fire stations separately.

Plans for dealing with fires in specific areas should be considered. Actual plans would depend upon the construction and arrangement of a particular ship, but principles such as containment of a fire, escape routes, access for fire fighters and the medium to be used can be dealt with. Trainees should be reminded that drills at sea should put these plans into action and that a different location for the fire should be chosen at each practice. It may be found that the plans need revising in the light of practice drills (V11).

Similarly, boat drills should sometimes be organized on the assumption that certain survival craft have been destroyed or are not usable for some reason.

The ship safety committee should be involved in the organization of emergency drills and the evaluation of the plans in the light of those drills. Representatives can bring any difficulties or deficiencies to the attention of the committee and suggest solutions to the problem. The committee can increase awareness of the actions required from crew members through their representatives.

The control centre for the command team in port should normally be at main deck level, at a location suitable for liaison with shore authorities. It should have a shore telephone connection and have emergency equipment and information stored there ready for use.

3.5 Organize and Manage the Crew

3.5.1 PERSONNEL MANAGEMENT, ORGANIZATION AND TRAINING ON BOARD SHIP

Officers will have different experiences of personnel management. As officers in charge of a watch they will also have had to exercise their authority. They will therefore recognize and understand many of the learning objectives. It should be possible to build on this and use their prior experience to the maximum to improve their knowledge and ability to cope with seagoing and other personnel such as pilots, ship agents, ship repairers and other shore staff.

There should also be a good opportunity to establish useful facts on the varying conditions of employment experienced by the group of trainees and perhaps to learn something of the advantages and disadvantages of the various systems which the trainees might find to be helpful in the course of their duties.

If time permits, the trainees should be given group assignments to recreate and learn how to deal with some of the typical arguments and problems which occur on board ship, (V4).

Organization of Staff
Once again, the experience of the trainees can be used as a basis to develop the various aspects of organizing staff. It is a wide subject and will vary according to the type of ship and, in some cases, the requirements of an Administration.

Training on Board Ships
Organisation and management skills are best learnt through teamwork activities and case studies. As much time as possible should be devoted to this aspect. Role playing exercises may be designed in communications, meetings, organising drills and training sessions, to name but a few areas, (T72). This is an important part of the course as it involves teaching various subjects to the trainees so that they, in due course, have the capability to train staff on board in the same subjects in order to improve safety and operational standards. There is scope in this section to use role playing and group assignments for some aspects of this training.

Nearly all of the training undertaken aboard ship will be on-the-job training, i.e. the trainee uses the normal ship's tools, equipment and materials during the ordinary running of the ship. Off-the-job training will probably be restricted to the use of video cassettes.

For trainee watchkeepers the STCW Convention requires that an approved programme of on board training is supervised and monitored and is adequately documented in a training record book (STCW Code Section A-II/1, paragraph 6). An example of one such book is that produced by the International Shipping Federation, see T71. Extensive guidance regarding training is given in the STCW Code Section B-II/1.

The purpose of training

All training is intended to modify attitudes, to increase skills or to provide knowledge which can be applied by the trainee in carrying out his work. The desired outcomes include a reduction in accidents, less need for supervision, greater productivity and improved quality of work. A thorough mastery of a task and a knowledge of its relevance to other tasks in the running of the ship also increase the job satisfaction of the crew member concerned.

Preparation

Before starting training, the instructor should prepare what he wishes to teach, decide the order of the instruction and make a note of the important points to be emphasized. Any tools or materials which are needed should be ready to hand and equipment, such as video players, should be tested to ensure that it is working.

Methods of training

For training to be effective, the trainee must be able to see that it is relevant to him and his work or duties on the ship. The instructor should question the trainees before starting to establish what they already know and can do and to explain why the task is necessary.

Nearly all on-board training is of an informal nature, often one-to-one, so trainees should be encouraged to ask questions or have demonstrations repeated, if necessary, during the training. The instructor should also question or test the trainees at suitable intervals to make sure that they have understood, or are able to perform the skill being taught, up to that point. Where appropriate, provide the trainee with a written note to support the tuition.

Changing attitudes

An attitude is an individual's habitual mode of responding to an object or situation. Attitudes are developed by experience within social groups, including those of the work place, and may become firmly implanted. To produce a change of attitude by training is therefore difficult and cannot be done quickly.

A crew member may know the correct safe working practice to adopt for a particular task and yet ignore it when not being directly supervised. The necessary insistence on following safe working practices will not necessarily change a careless attitude to safety. A discussion of the consequences to himself and his family of an accident resulting in permanent disablement might be more effective. Officers should remember that their own attitudes and behaviour help to form those of trainees and new entrants, who will not develop desirable attitudes to required standards if their seniors do not adopt them or if they ignore breaches of them by others, see V12.

Training in skills

On-the-job training usually consists of putting the trainee to watch and work with an experienced person (e.g. a cadet, watchkeeping with a qualified officer). This arrangement fails if the experienced person uses incorrect methods in his work.

In teaching a particular skill, such as a manual task, the instructor should divide the task into self-contained stages, each of which can be taught as a unit. He should identify any critical points at each stage. The job is demonstrated and explained to the trainees in stages, with emphasis on the critical points. The trainee then carries out the job under the supervision of the instructor. Stages are repeated as necessary until the trainees' performances are satisfactory, (V13).

Training in knowledge
In the majority of cases aboard ship this will involve an officer or petty officer describing equipment or a particular task to others, for example, instruction in how to launch an inflatable liferaft and board it, and how to survive when in it. Trainees should be encouraged to participate in the instruction by asking questions or making suggestions. Sufficient questions should be directed to trainees to test that the necessary knowledge is being transferred.

Knowledge which is not often used (how to survive in a liferaft, for example) is forgotten with the passage of time, hence the necessity for repeating such instruction at intervals.

Each trainee should deliver a short training session (about 10 minutes would be sufficient) to the other members of the class. Subjects, which should be drawn from those which would be undertaken aboard ship, should be assigned to the trainees well in advance to allow them ample time for preparation.

3.5.2 RELATED INTERNATIONAL MARITIME CONVENTIONS AND NATIONAL LEGISLATION

It is suggested that where national legislation implementing an international agreement or convention exists, both the national legislation and the international requirements are taught together. For example, a topic could be treated by dealing with the national legislation, including the administrative details necessary for the master to carry out his duties effectively, and making reference to the relevant sections of the international agreement or convention on which the national regulations are based.

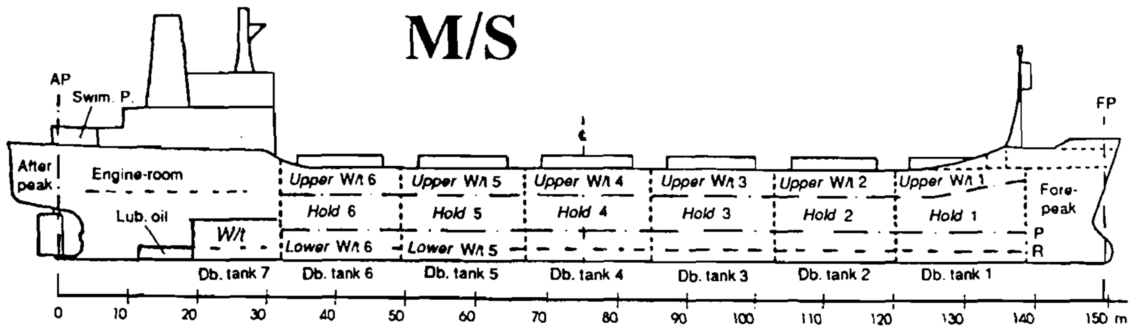
In addition to the national laws implementing the international conventions and agreements, the following areas of concern to a ship's master, not touched upon in the syllabus, are mentioned:

- a review of the national system of courts, hearings and appeals
- the procedures for preliminary enquiry and formal investigation of accidents
- contracts of towage
- the law concerning pilotage
- stowaways
- the carriage of the official log-book, entries and surrender of the log-book at the completion of a voyage
- crew disciplinary procedures, powers and obligations of the master
- the master's disciplinary powers concerning passengers
- calculation of crew wages, rules concerning allotment of wages, deductions of tax and social security contributions, advances, fines, forfeitures, other deductions and payment of the balance
- collective bargaining agreements between seafarers' and shipowners' organizations affecting the employment of crew

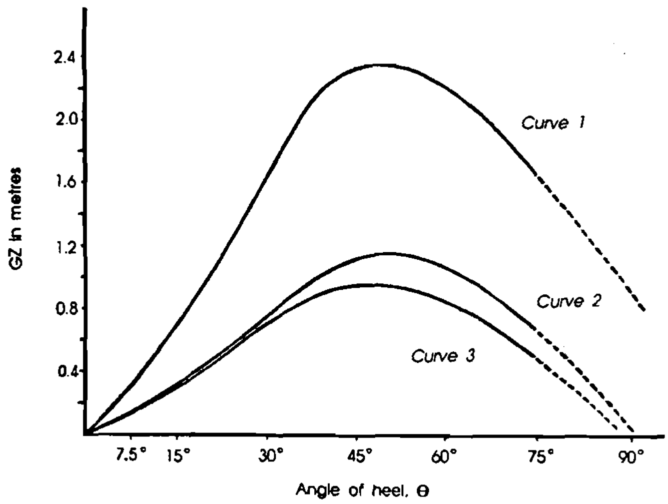
3.6 Organise and Manage the Provision of Medical Care on Board

The standards of competence required by the STCW Convention are covered by IMO Model Course 1.15, Medical Care, T67, and V16. However, officers need to know where to get appropriate advice and how to apply it correctly. The three main sources of information are the publications mentioned in this section.

Appendix – Stability Data



Curves of statical stability



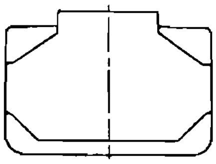
Curve	Condition	Cargo	H.O.	D.O.	Stores
1	Ballast	–	695.6	155.3	150
2	Load 1	14 894.3	250.0	53.5	150
3	Load 2	16 040.0	200.0	51.2	150

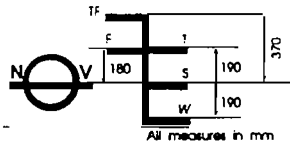
Curve	F/W	Ballast	L/S	Δ
1	263.3	5070.5	4895	11 229.7
2	104.8	672.4	4895	21 020
3	104.8	–	4895	21 441

Curve	KG	GG_1	Corrected KG	GM
1	6.54	–	6.54	2.56
2	7.113	0.043	7.156	1.484
3	7.320	0.043	7.363	1.307

Capacities in tanks	Volume in m^3	Weights in tonnes					Centre of Gravity		Free surface $I = \frac{l \times b^3}{12}$ m^4
		Lub. oil ($\rho = 0.9$)	Diesel oil ($\rho = 0.9$)	Fuel oil ($\rho = 0.95$)	Fresh w. ($\rho = 1.0$)	Ballastw. ($\rho = 1.02$)	VCG (metres)	From AP (metres)	
Forepeak	268.4					275.1	7.28	142.77	67
Db. tank No. 1	2 × 214.0					438.7	1.49	128.44	495
Db. tank No. 2	2 × 296.0					606.8	1.19	110.64	2757
Db. tank No. 3	2 × 328.0					672.4	1.13	93.39	2936
Db. tank No. 4	2 × 328.0					672.4	1.13	75.80	2936
Db. tank No. 5	2 × 191.3			363.5		392.2	0.76	58.22	1094
Db. tank No. 6	2 × 174.8			332.1		358.3	0.76	40.78	785
Db. tank No. 7	2 × 86.3		155.3				1.34	24.69	81
Lower W/t. No. 5	2 × 136.1					279.0	1.76	58.46	81
Lower W/t. No. 6	2 × 100.8			191.5		206.6	1.89	40.63	55
W/t. Eng. Room	2 × 145			275.5			4.88	26.79	120
Upper W/t. No. 1	2 × 149.5					306.1	11.67	127.41	152
Upper W/t. No. 2	2 × 204.8					419.8	11.25	110.98	393
Upper W/t. No. 3	2 × 204.8					419.8	11.25	93.39	393
Upper W/t. No. 4	2 × 204.8					419.8	11.25	75.80	393
Upper W/t. No. 5	2 × 204.8					419.8	11.25	58.22	393
Upper W/t. No. 6	2 × 204.8					419.8	11.25	40.60	393
After-peak	158.5				158.5		7.98	3.44	206
Swim. pool	32				30	30.8	21.86	2.20	24
Freshw. tank	2 × 52.4				104.8		11.40	5.27	83
Daily diesel tank	52.2		47.0				10.76	15.00	39
Daily fuel oil tank	71.1			67.5			10.82	11.22	102
Diesel oil tank	6.0		5.4				13.99	28.53	1
Lub. oil tank	40.0	36.0					10.76	29.81	4
Lub. oil tank	2 × 20.8	37.4					0.67	20.60	20
Total:			207.7	1230.1	293.3	6307.1			

Loading scale





TF	17039 tonnes deadweight at 9.35 m				
F	16538	"	"	"	9.16 m
T	17057	"	"	"	9.17 m
S	16546	"	"	"	8.98 m
W	16037	"	"	"	8.79 m

Ships data

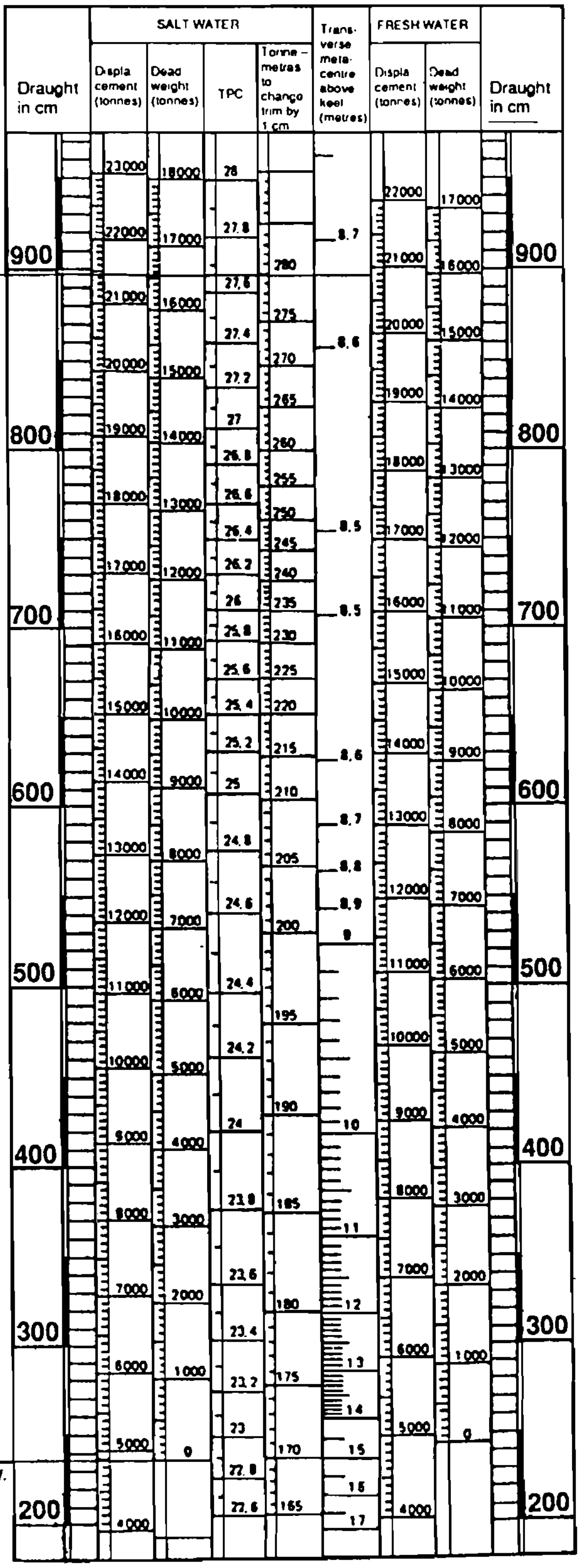
LOA = 159.4 m
LBP = 149.35 m
B = 20.4 m
D = 12.5 m
Gross = 11 182 tonnes
Net = 5 971 tonnes
Δ (s) = 21 441 tonnes
C_b (s) = 0.765

Light ship:

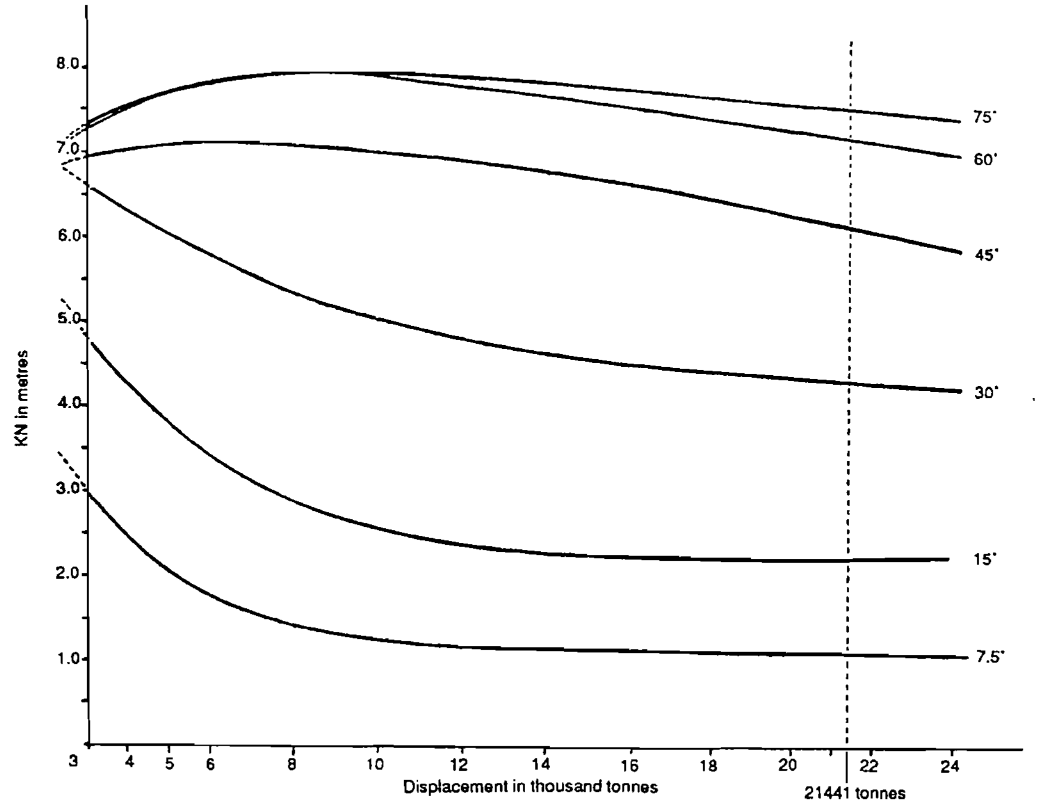
Displacement 4 895 tonnes
Draught F 0.25 m, A 4.62 m, M 2.43 m
VCG 7.8 m
LCG from AP 61.587 m

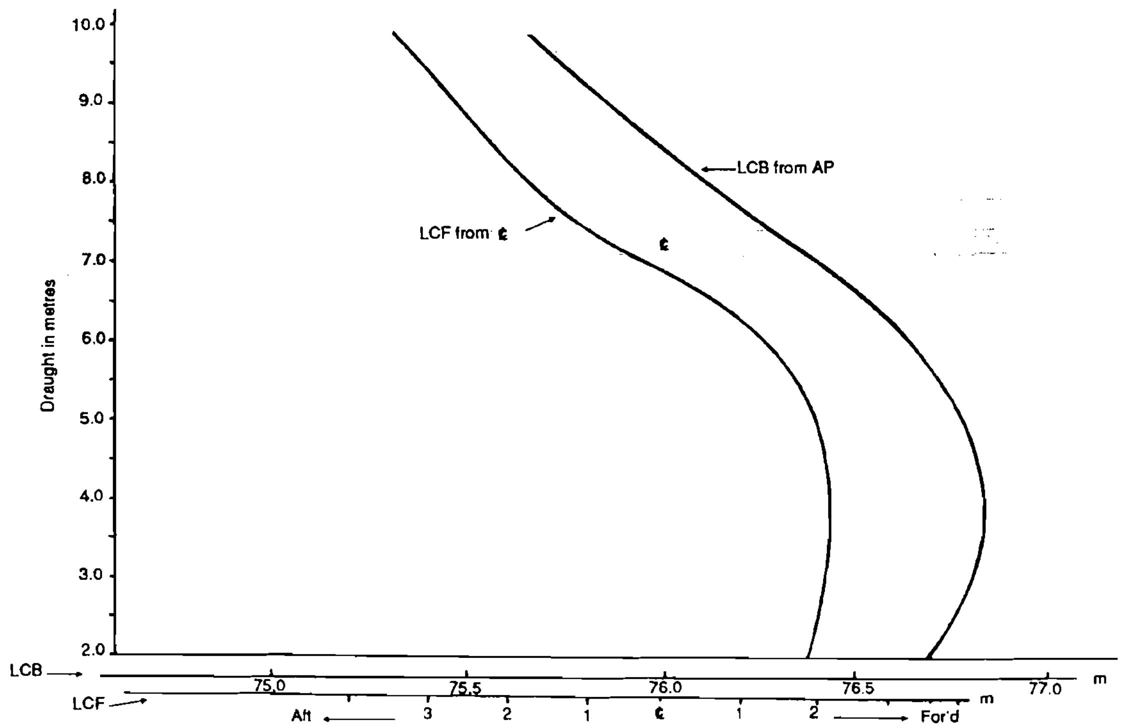
Cargo holds:

Hold No.	Volume (m^3) Grain	Bales	Centre of Gravity VCG (m)	from AP (m)
1	2 919	2 761	7.83	128.32
2	3 577	3 435	7.14	111.43
3	3 607	3 465	7.13	93.88
4	3 607	3 465	7.13	76.29
5	3 603	3 460	7.13	58.73
6	3 539	3 430	7.19	41.09
Total:	20 852	20 017		



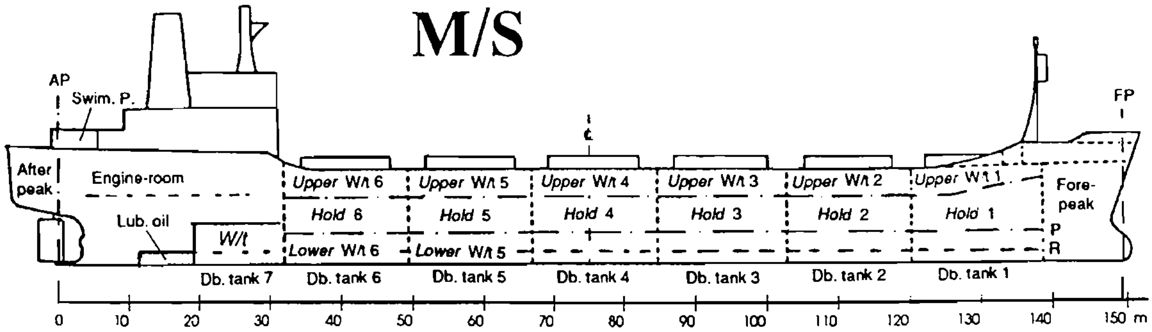
KN Curves


KN in metres
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
75°
60°
45°
30°
15°
7.5°
3
4
5
6
8
10
12
14
16
18
20
22
24
Displacement in thousand tonnes
21441 tonnes


Draught in metres
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
LCB from AP
LCF from ℄
℄
LCB
LCF
75.0
75.5
76.0
76.5
77.0
m
Aft
3
2
1
℄
1
2
For'd
m

Appendix – Trim Table

Tables of changes in centimetres of draught forward and aft for each 100 tonnes loaded.



3.0m Draught

F	-16	-13	-10	-6	-1	+4	+9	+14	-18	+23	F
A	+26	+22	+19	+15	+10	+5	0	-6	-11	-15	A

6.0m Draught

F	-15	-10	-8	-4	0	+4	+8	+12	+16	+20	F
A	+23	+19	+17	+13	+8	+4	0	-4	-9	-12	A

9.0m Draught

F	-9	-7	-5	-2	+1	+4	+7	+11	+14	+17	F
A	+15	+13	+12	+9	+6	+3	0	-3	-6	-9	A

Example – Find the draughts after loading 250 tonnes in No. 2 hold.

Initial draught	forward 5.76 m	aft 6.38 m	
Correction	+0.30	–0.10	$\left(\frac{250}{100} \times \text{tabulated values}\right)$
New draught	6.06 m	6.28 m	

Notes 1. Interpolation can be used for intermediate draughts.

2. Reverse the signs of the corrections for discharged weights.

Part C3: Detailed Teaching Syllabus

Introduction

The detailed teaching syllabus is presented as a series of learning objectives. The objective, therefore, describes what the trainee must do to demonstrate that the specified knowledge or skill has been transferred.

Thus each training outcome is supported by a number of related performance elements in which the trainee is required to be proficient. The teaching syllabus shows the *Required performance* expected of the trainee in the tables that follow.

In order to assist the instructor, references are shown to indicate IMO references and publications, textbooks and teaching aids that instructors may wish to use in preparing and presenting their lessons.

The material listed in the course framework has been used to structure the detailed teaching syllabus; in particular,

Teaching aids (indicated by A)
IMO references (indicated by R) and
Textbooks (indicated by T)

will provide valuable information to instructors.

Explanation of Information Contained in the Syllabus Tables

The information on each table is systematically organised in the following way. The line at the head of the table describes the FUNCTION with which the training is concerned. A function means a group of tasks, duties and responsibilities as specified in the STCW Code. It describes related activities which make up a professional discipline or traditional departmental responsibility on board.

In this Model course there are three functions:

Navigation at the Management Level
Cargo Handling and Stowage at the Management Level
Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

The header of the first column denotes the **COMPETENCE** concerned. Each function comprises a number of competences. For example, the Function 3, Controlling the Operation of the Ship and Care for Persons on board at the Management Level, comprises a number of COMPETENCES. Each competence is uniquely and consistently numbered in this model course.

In this function the competence is **Control trim, stability and stress.** It is numbered 3.1, that is the first competence in Function 3. The term competence should be understood as the application of knowledge, understanding, proficiency, skills, experience for an individual to perform a task, duty or responsibility on board in a safe, efficient and timely manner.

Shown next is the required TRAINING OUTCOME. The training outcomes are the areas of knowledge, understanding and proficiency in which the trainee must be able to demonstrate knowledge and understanding. Each COMPETENCE comprises a number of training outcomes. For example, the above competence comprises three training outcomes. The first is concerned with the fundamental principles of FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY. Each training outcome is uniquely and consistently numbered in this model course. That concerned with fundamental principles of Ship Construction, Trim And Stability is uniquely numbered 3.1.1. For clarity training outcomes are printed in black on grey, for example TRAINING OUTCOME.

Finally, each training outcome embodies a variable number of Required performances – as evidence of competence. The instruction, training and learning should lead to the trainee meeting the specified Required performance. For the training outcome concerned with fundamental principles of ship construction, trim and stability there are three areas of performance. These are :

3.1.1.1 Shipbuilding materials
3.1.1.2 Welding
3.1.1.3 Bulkheads

Following each numbered area of Required performance there is a list of activities that the trainee should complete and which collectively specify the standard of competence that the trainee must meet. These are for the guidance of teachers and instructors in designing lessons, lectures, tests and exercises for use in the teaching process. For example, under the topic 3.1.1.1, to meet the Required performance, the trainee should be able to:

- states that steels are alloys of iron, with properties dependent upon the type and amounts of alloying materials used
- states that the specifications of shipbuilding steels are laid down by classification societies
- states that shipbuilding steel is tested and graded by classification society surveyors who stamp it with approval marks

and so on.

IMO references (Rx) are listed in the column to the right hand side. Teaching aids (Ax), videos (Vx) and textbooks (Tx) relevant to the training outcome and required performances are placed immediately following the TRAINING OUTCOME title.

It is not intended that lessons are organised to follow the sequence of Required performances listed in the Tables. The Syllabus Tables are organised to match with the competence in the STCW Code Table A-II/2. Lessons and teaching should follow college practices. It is not necessary, for example, for ship building materials to be studied before stability. What is necessary is that <u>all</u> the material is covered and that teaching is effective to allow trainees to meet the standard of the Required performance.

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

TRAINING OUTCOMES:

STCW Code
Table A-II/2

Demonstrates a knowledge and understanding of:

3.1.1 FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION TRIM AND STABILITY

3.1.2 EFFECT ON TRIM AND STABILITY IN THE EVENT OF DAMAGE AND FLOODING

3.1.3 KNOWLEDGE OF IMO RECOMMENDATIONS CONCERNING SHIP STABILITY

COMPETENCE 3.1 **Control Trim, Stability and Stress** **IMO Reference**

3.1.1 FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY

Textbooks: T11, T12, T35, T58, T69
Teaching aids: A1, A4, V5, V6, V7

Required performance:

1.1 Shipbuilding Materials (3 hours) R1

- states that steels are alloys of iron, with properties dependent upon the type and amounts of alloying materials used
- states that the specifications of shipbuilding steels are laid down by classification societies
- states that shipbuilding steel is tested and graded by classification society surveyors, who stamp it with approval marks
- explains that mild steel, graded A to E, is used for most parts of the ship
- states why higher tensile steel may be used in areas of high stress, such as the sheer strake
- explains that the use of higher tensile steel in place of mild steel results in a saving of weight for the same strength
- explains what is meant by:
  - tensile strength
  - ductility
  - hardness
  - toughness
- defines strain as extension divided by original length
- sketches a stress-strain curve for mild steel
- explains:
  - yield point
  - ultimate tensile stress
  - modulus of elasticity
- explains that toughness is related to the tendency to brittle fracture
- explains that stress fracture may be initiated by a small crack or notch in a plate
- states that cold conditions increase the chances of brittle fracture
- states why mild steel is unsuitable for the very low temperatures involved in the containment of liquefied gases
- lists examples where castings or forgings are used in ship construction
- explains the advantages of the use of aluminium alloys in the construction of superstructures
- states that aluminium alloys are tested and graded by classification society surveyors
- explains how strength is preserved in aluminium superstructures in the event of fire

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

- describes the special precautions against corrosion that are needed where aluminium alloy is connected to steelwork

1.2 Welding (3 hours) — R1

- describes the process of manual electric arc welding
- explains the purpose of flux during welding
- describes briefly the automatic welding processes, electro-slag, TIG and MIG
- describes butt, lap and fillet welds
- describes the various preparations of a plate edge for welding
- explains what is meant by a full-penetration fillet weld
- explains what is meant by 'single pass', 'multipass' and 'back' run
- explains how welding can give rise to distortion and describes measures which are taken to minimize it
- describes the use of tack welding
- describes weld faults:
  - lack of fusion
  - no inter-run penetration
  - lack of reinforcement
  - lack of root penetration
  - slag inclusion
  - porosity
  - overlap
  - undercut
- states that classification societies require tests on weld materials and electrodes before approving them
- describes gas cutting of metals

1.3 Bulkheads (4 hours) — R1

- states that transverse bulkheads serve to subdivide a ship against flooding and spread of fire, to support decks and superstructures and to resist racking stresses
- distinguishes between watertight, non-watertight and oil-tight or tank bulkheads
- defines:
  - margin line
  - bulkhead deck
  - weather tight
- states that cargo ships must have:
  - a collision bulkhead, watertight up to the freeboard deck, positioned not less than 5% of the length of the ship (or 10 metres, whichever is the less) and not more than 8% of the length of the ship from the forward perpendicular
  - an afterpeak bulkhead enclosing the stern tube and rudder trunk in a watertight compartment
  - a bulkhead at each end of the machinery space

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

- explains that cargo ships require additional bulkheads, as laid down by classification society rules, according to their length
- describes the construction of a watertight bulkhead and its attachments to sides, deck and tank top
- describes how water tightness is maintained where bulkheads are pierced by longitudinal, beams or pipes
- states the rule regarding penetrations of the collision bulkhead — R2
- states that watertight floors are fitted directly below main watertight bulkheads
- explains that oil tight bulkheads and bulkheads forming boundaries of tanks are built with heavier scantlings than watertight bulkheads
- describes how bulkheads are tested for tightness
- gives examples of non-watertight bulkheads
- explains the purpose of washing bulkheads in cargo tanks or deep tanks
- states longitudinal bulkheads serve to subdivide liquid cargoes, provide additional longitudinal support and reduce free surface effect
- distinguishes between Cofferdam, Flat plate and Corrugated bulkhead construction
- explains the use of cross ties in tanker construction

1.4 Watertight and Weather tight Doors (3 hours) — R1

- states that openings in watertight bulkheads must be fitted with watertight doors
- states that the number of openings in watertight bulkheads of passenger ships should be reduced to the minimum compatible with the design and working of the ship — R2
- categorizes watertight doors as:
  class 1 – hinged doors
  class 2 – hand-opened sliding doors
  class 3 – sliding doors which are power-operated as well as hand-operated
- states that all types of watertight doors should be capable of being closed with the ship listed to 15° either way
- describes with sketches the arrangement of a power-operated sliding watertight door
- describes with sketches a hinged watertight door, showing the means of securing it
- states that hinged watertight doors are only permitted above a deck at least 2.0 metres above the deepest subdivision load line
- explains that weather tight doors in superstructure openings are similar to hinged watertight doors
- states that drills for the operating of watertight doors, side scuttles, valves and other closing mechanisms must be held weekly
- states that all watertight doors in main transverse bulkheads, in use at sea, must be operated daily

- states that watertight doors and their mechanisms and indicators, all valves the closing of which is necessary to make a compartment watertight and all valves for damage-control cross-connections must be inspected at sea at least once per week

- states that records of drills and inspections are to be entered in the log, with a record of any defects found

1.5 Corrosion and its Prevention (4 hours) R1

- explains what is meant by corrosion

- explains what is meant by erosion of metals and gives examples of where this is likely to occur

- describes the formation of a corrosion cell and defines anode, cathode and electrolyte

- states that corrosion takes place at the anode while the cathode remains unaffected

- describes the galvanic series of metals in seawater

- given the galvanic series, states which of two metals will form the anode in a corrosion cell

- explains the differences in surface condition or in stress concentration can give rise to corrosion cells between two areas of the same metal

- states that corrosion can be controlled by:
  - applying a protective coating to isolate the steel from the air or from seawater electrolyte
  - using cathodic protection to prevent steel from forming the anode of a corrosion cell

- explains that cathodic protection can only be used to protect the underwater hull or ballasted tanks

- states that both of the methods mentioned above are normally used together

- explains what mill scale is and states that it is cathodic to mild steel

- describes the treatment of steel in a shipyard and the use of holding primers (shop primers)

- explains that the required preparation of steelwork depends upon the type of paint to be applied

- states that many modern paints, such as epoxy and polyurethane, need to be applied to a very clean shot-blasted surface

- states that paints consist mainly of a vehicle, a pigment and a solvent, and explains the purpose of each

- lists common paint vehicles as:
  - drying oils
  - oleo-resins
  - alkyd resins
  - polymerizing chemicals
  - bitumen

  and states the suitability of each for various applications

- describes the action of anti-fouling paint

COMPETENCE 3.1 Control Trim, Stability and Stress **IMO Reference**

- describes the use of self-polishing anti-fouling paint, and the proposed banning of Tributyltin (TBT)
- describes typical paint schemes for:
  - underwater areas
  - boot topping
  - topsides
  - weather decks
  - superstructures
  - tank interiors
- states the safety precautions to take when using paints
- describes the system of cathodic protection using sacrificial anodes
- lists the metals and alloys which may be used as anodes
- explains why anodes of magnesium and of magnesium alloy are not permitted in cargo/ballast tanks and in adjacent tanks in tankers
- states that good electrical contact between the anode and the hull or tank is essential
- explains why the anodes are insulated from the hull
- describes the impressed-current system of hull protection
- explains that the system is adjusted for optimum protection, often automatically, by use of a reference cell
- states that electrical connection with the hull via slip rings and brushes on the rudder stock and propeller shaft ensures protection of the rudder and propeller
- explains that, as the underwater paintwork deteriorates, higher currents are required for protection
- states that too high a current can result in damage to paintwork and a chalky deposit on areas of bare metal, which has to be removed before repainting can be carried out
- states that a protective shield of epoxy resin is applied for about 1 metre around the anodes to withstand the alkaline conditions there

1.6 Surveys and Dry-docking (2 hours) R1

- states the frequency of classification society surveys
- states that intervals between dry-dockings may be extended up to 2.5 years where a ship has high-resistance paint and an approved automatic impressed-current cathodic protection system
- states that continuous hull survey, in which all compartments are examined over a 5-year period, may replace the special surveys
- lists the items inspected at annual survey as:
  - protection of openings: hatches, ventilators, cargo doors, side scuttles, overside discharges and any other openings through which water might enter
  - guardrails
  - water-clearing arrangements, freeing ports, scuppers
  - means of access to crew's quarters and working areas
- states that the inspections listed above are also required for the annual inspection under the International Convention on Load Lines, 1966 R4

COMPETENCE 3.1 Control Trim, Stability and Stress **IMO Reference**

- lists the items to examine in dry-dock as:
  - shell plating
  - cathodic protection fittings
  - rudder
  - stern frame
  - propeller
  - anchors and chain cable
- describes the examinations to be made of the items listed above
- describes the cleaning, preparation and painting of the hull in dry-dock
- calculates paint quantities, given the formula for wetted surface area as:

  $S = 2.58 \sqrt{\Delta L}$

  where S = surface area in m^2
  Δ = displacement in tonnes
  L = length of ship in metres

1.7 **Stability** (83 hours)

Approximate Calculation of Areas and Volumes

- states the trapezoidal rule for the area under a curve in terms of the number of ordinates, the interval and the ordinate values
- uses the trapezoidal rule to find the area under a curve defined by given ordinates
- states Simpson's first rule as

  $$A = h\,(y_1 + 4y_2 + y_3)/3$$

  where: A = area under curve
  h = interval length
  y_1, y_2, y_3 are ordinates
- writes down the repeated first rule for any odd number of ordinates
- uses Simpson's first rule to find the area under a curve defined by an odd number of ordinates
- states that the area is exact for a linear, quadratic or cubic curve but an approximation otherwise
- states, Simpson's second rule as

  $$A = 3h\,(y_1 + 3y_2 + 3y_3 + y_4)/8$$

  where: A = area
  h = interval length
  y_1, y_2, y_3, y_4 are ordinates
- writes down the repeated second rule for 7, 10, 13, etc. ordinates
- uses Simpson's second rule to find the area under a curve defined by a suitable number of given ordinates
- states that the area is exact for linear, quadratic or cubic curves
- states that the first rule has smaller errors that the second and should be used in preference where possible

COMPETENCE 3.1 Control Trim, Stability and Stress **IMO Reference**

- states that errors can be reduced by using a smaller interval
- states the 5, 8, -1 rule as $A = h(5y_1 + 8y_2 - y_3)/12$

  where: A = area between first and second ordinates
  h = interval length
  y_1, y_2, y_3 are ordinates
- uses Simpson's rules to find the area under a curve defined by any number of ordinates
- explains that the volume of a body may be calculated by using Simpson's rules with cross-sectional areas as ordinates
- calculates the volume of a ship to a stated draught by applying Simpson's rules to given cross-sectional areas or waterplane areas

Effects of Density

- given the density of the water in the dock, calculates the displacement for a particular draught from the seawater displacement for that draught extracted from hydrostatic data
- calculates the TPC for given mean draught and density of the dock water
- derives the formula FWA = $\frac{\Delta}{40\ TPC}$ cm, where Δ is the displacement in

  salt water in tonnes at the summer load line and TPC is the tonnes per centimetre immersion in salt water at the summer load line
- states that FWA only applies when the ship is floating at or near its summer load line
- explains why the density of the water in the dock should be taken at the same time as the draughts are read
- states that the rise of G due to free surface affect (in metres)

  $$= \frac{\text{inertia of tank } (m^4) \times \text{density of liquid in tank}}{\text{Displacement of the ship in tonnes}}$$

  where the density of the liquid is measured in tonne/m³
- states that the inertia of the tank (I) is the second moment of area of the liquid surface about a fore-and-aft axis through the centre of area
- states that for a rectangular tank, $I = \frac{L\,b^3}{12}$

  L = length of tank
  b = breadth of tank
  I = second moment of area about a fore-and-aft axis through the centre
- deduces from the above objective that halving the breadth of a tank reduces the free surface effect to one eight of its original value
- deduces that subdividing a tank at the centre reduces its free surface effect to one quarter of that of the undivided tank
- states that the quantity 'inertia x density of liquid' is called the 'free surface moment' of the tank, in tonne-metres
- states that information for calculating free surface effect is included in tank capacity tables

- states that the information may be given in one of the following ways:
  – inertia in $metre^4$
  – free surface moments for a stated density of liquid in the tank
  – as a loss of GM, in tabulated form for a range of draughts (displacements) for a stated density of liquid in the tank
- corrects free surface moments when a tank contains a liquid of different density from that stated in the capacity table
- given a ship's displacement and the contents of its tanks, uses the information from a capacity table to calculate the loss of GM due to slack tanks
- given a ship's departure conditions and the daily consumption of fuel, water and stores, calculates the GM on arrival at destination

Stability at Moderate and Large Angles of Heel

- states that the formula $GZ = GM \sin\theta$ does not hold for angles in excess of about 10°
- states that the initial KM is calculated from

  $KM = KB + BM$
- uses a metacentric diagram to obtain values of KM, KB and BM for given draughts
- states that the transverse $BM = \frac{I}{V}$

  Where: I = second moment of area of the waterplane about the centre line;
  V = underwater volume of the ship
- states that for a rectangular waterplane $I = \frac{LB^3}{12}$

  where: L is the length of the waterplane;
  B is the breadth of the waterplane
- shows that, for a box-shaped vessel, $KM = \frac{B^2}{12d} + \frac{d}{2}$

  where: d = draught
- states that, for moderate and large angles of heel, values of GZ found by calculating the position of the centre of buoyancy are provided by the shipbuilder for a range of displacements and angles of heel for an assumed position of the centre of gravity
- uses cross-curves of stability and KN curves to construct a curve of statical stability for a given displacement and value of KG, making correction for any free surface moments
- explains how to use the initial metacentric height as an aid to drawing the curve
- identifies from the curve the approximate angle at which the deck edge immerses
- describes the effect of increased freeboard on the curve of statical stability for a ship with the same initial GM
- states that the righting lever, GZ, may be found from the wall-sided formula up to the angle at which the deck edge is immersed
- given the wall-sided formula $GZ = (GM + \frac{BM}{2}\tan^2\theta)\sin\theta$

  and other relevant data, calculates the value of GZ for a stated angle of heel

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

- shows that, for small angles of heel, the term $\frac{BM}{2}\tan^2\theta$ is negligible, leading to the usual expression for GZ at small angles of heel
- uses the wall-sided formula for calculating the angle of loll of an initially unstable ship
- compares the result in the above objective with that obtained by connecting a curve of statical stability
- states that cross-curves and KN curves are drawn for the ship with its centre of gravity on the centre line
- demonstrates how to adjust the curve of statical stability for a ship with a list
- describes the effect when heeled to the listed side on:
  - the maximum righting moment
  - the angle of vanishing stability
  - the range of stability
- states that cross-curves and KN curves are drawn for the ship at the designed trim when upright
- states that righting levers may differ from those shown if the ship has a large trim when upright

Simplified Stability Data

- states that stability information may be supplied in a simplified form, consisting of:
  - a diagram or table of maximum deadweight moment
  - a diagram or table of minimum permissible GM
  - a diagram or table of maximum permissible KG

  all related to the displacement or draught in salt water
- states that a deadweight moment is mass in tonnes x vertical height of the mass above the keel
- states that free surface moments are to be added to the deadweight moments when using the diagram of maximum deadweight moment
- states that if, for a stated displacement or draught, the total deadweight moment or KG is less than the maximum permissible value, the ship will have adequate stability
- reads the maximum permissible deadweight moment from a curve of deadweight moment for a given displacement
- given the masses loaded, their heights above the keel and the free surface moments of slack tanks, calculates the deadweight moment and uses the result with the diagram of deadweight moment to determine if the stability is adequate
- uses the diagram of deadweight moment to calculate the maximum mass that can be loaded in a given position to ensure adequate stability during a voyage, making allowance for the fuel, water and stores consumed and for any resulting free surface
- states that curves of maximum KG or minimum GM to ensure adequate stability in the event of partial loss of intact buoyancy are provided in passenger ships R1, R2

Trim and List R1

- defines longitudinal centre of gravity (LCG) and longitudinal centre of buoyancy (LCB)
- states that a ship trims about the centre of flotation until LCG and LCB are in the same vertical line

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

- states that a ship trims about the centre of flotation until LCG and LCB are in the same vertical line

- states that the distance of the LCB from amidships or from the after perpendicular is given in a ship's hydrostatic data for the ship on an even keel

- explains that the LCG must be at the same distance from amidships as LCB when the ship floats on an even keel

- shows on a diagram of a ship constrained to an even keel the couple that is formed by the weight and buoyancy forces when LCG is not the same distance from amidships as LCB

- states that the trimming moment = displacement x the horizontal distance between LCB (tabulated) and LCG (actual) = Δ x GG1

  where GG1 is the horizontal distance between the position of LCG for the even-keel condition and the actual LCG

- states that trim = $\frac{\Delta \times GG1}{MCT\ 1cm}$

- states that if the actual LCG is abaft the tabulated position of LCB, then the trim will be by the stern, and vice versa

- given the initial displacement, initial position of LCG, masses loaded or discharged and their LCGs, calculates the final position of LCG

- using a ship's hydrostatic data and a given disposition of cargo, fuel, water and stores, determines the trim, the mean draught and the draughts at each end

- calculates the mass to move between given positions to produce a required trim or draught at one end

- calculates where to load a given mass to produce a required trim or draught at one end

- calculates how to divide a loaded or discharged mass between two positions to produce a required trim or draught at one end

- calculates where to load a mass so as to keep the after draught constant

- states that calculated draughts refer to draughts at the perpendiculars

- given the distance of draught marks from the perpendiculars and the length between perpendiculars, corrects the draughts indicated by the marks

- given draughts forward, aft and amidships, states whether or not the ship is hogged or sagged and the amount

- corrects the draught amidships for hog or sag

- given the forward and after draughts, the length between perpendiculars and hydrostatic data, calculates the correction for trim to apply to the displacement corresponding to the draught amidships

- states that a second correction for trim, using Nemoto's formula, may be applied to the displacement

- given Nemoto's formula, calculates the second correction to displacement

- calculates the maximum list during loading or discharging a heavy lift, using a ship's derrick, given the relevant stability information and the dimensions of the derrick

- calculates the minimum GM required to restrict the list to a stated maximum when loading or discharging a heavy lift

COMPETENCE 3.1 Control Trim, Stability and Stress **IMO Reference**

- calculates the quantities of fuel oil or ballast to move between given locations to simultaneously correct a list and achieve a desired trim
- explains how to distinguish between list and loll and describes how to return the ship to the upright in each case
- by making use of curves of statical stability, including those for ships with zero or negative initial GM, determines the equilibrium angle of heel resulting from a transverse moment of mass

Dynamical Stability

- defines dynamical stability at any angle of heel as the work done in inclining the ship to that angle
- states that the dynamical stability at any angle is given by the product of displacement and the area under the curve of statical stability up to that angle
- given a curve of statical stability, uses Simpson's rules to find the area in metre-radians up to a stated angle
- states that dynamical stability is usually expressed in tonne-metres
- explains that the dynamical stability at a given angle of heel represents the potential energy of the ship
- states that the potential energy is used partly in overcoming resistance to rolling and partly in producing rotational energy as the ship returns to the upright
- states that the rotational energy when the ship is upright causes it to continue rolling
- states that, in the absence of other disturbing forces, the ship will roll to an angle where the sum of the energy used in overcoming resistance to rolling and the dynamical stability are equal to the rotational energy when upright
- states that a beam wind exerts a force equal to the wind pressure multiplied by the projected lateral area of the portion of the ship and deck cargo above the waterline
- explains that a heeling moment is formed, equal to the force of the wind multiplied by the vertical separation between the centres of the lateral areas of the portions of the ship above and below the waterline
- states that the heeling lever equals the heeling moment divided by the ship's displacement
- states that a steady wind will cause a ship to heel to an angle at which the righting lever is equal to the heeling over
- states that a ship under the action of a steady wind would roll about the resulting angle of heel
- on a curve of righting levers, indicates the angle of equilibrium under the action of a steady wind and the areas which represent the dynamical stability at angles of roll to each side of the equilibrium position
- by reference to dynamical stability, describes the effect of an increase in wind pressure when a vessel is at its maximum angle of roll to windward
- summarizes the recommendation on severe wind and rolling criterion for the intact stability of passenger and cargo ships R6
- by reference to a curve of righting levers and dynamical stability, describes the effect of a listing moment on the rolling of the ship about the equilibrium position

COMPETENCE 3.1 Control Trim, Stability and Stress **IMO Reference**

Approximate GM by Means of Rolling Period Tests R1, R6

- states that, for ships up to 70m in length, the GM can be verified in still water by causing the ship to roll and noting the rolling period
- defines the rolling period as the time taken for one complete oscillation from the extreme end of a roll to one side, right across to the extreme on the other side and back to the original position
- states that for small angles of roll in still water, the initial metacentric height, GMo is given by:

  $$GMo = \left[\frac{fB}{Tr}\right]^2$$

  where: f = rolling factor
  B = breadth of the ship
  Tr = rolling period in seconds
- states that the formula may be given as:

  $$GMo = \frac{F}{Tr^2}$$

  where the F-value is provided by the Administration
- summarizes the procedures for determining a ship's stability by means of the rolling period test
- given values of F and T and the equation $GMo = \frac{F}{T^2}$, calculates GMo
- states the limitations of the method
- states the limitations of the method states that when construction is completed, a ship undergoes an inclining test to determine the displacement and position of the centre of gravity, KG and LCG, in the light ship condition
- states that the displacement and KM are calculated from the observed draughts and the ship's lines plans, making allowance for density of water and trim
- states that the position of the centre of buoyancy is calculated to enable the LCG for the light ship to be determined
- describes how an inclining test is carried out
- given the mass and the distance through which it was moved, the displacement, length of the plumb line and the deflection, calculates the KG
- states that the values obtained in a test are corrected for masses to be removed and added to obtain the KG and LCG for the light ship
- states that, at periodical intervals not exceeding five years, a light ship survey must be carried out on all passenger ships to verify any changes in light ship displacement and longitudinal centre of gravity R2
- states that the ship must be re-inclined whenever, in comparison with the approved stability information, a deviation from the light ship displacement exceeding 2% or a deviation of the longitudinal centre of gravity exceeding 1% of L is found or anticipated

COMPETENCE 3.1 **Control Trim, Stability and Stress** **IMO Reference**

Recommendation on Intact Stability for Passenger and Cargo Ships under 100 Metres in Length

R1, R6

- describes the general precautions to be taken against capsizing
- states the recommended criteria for passenger and cargo ships
- given the initial metacentric height and the GZ curve, determines whether the ship meets the recommended criteria
- states that stability information should comprise:
  - stability characteristics of typical loading conditions
  - information to enable the master to assess the stability of the ship in all loading conditions differing from the standard ones
  - information on the proper use of anti-rolling devices, if fitted
  - information enabling the master to determine GMo by means of a rolling test
  - corrections to be made to GMo for free surface liquids
  - for ships carrying timber deck cargoes, information setting out changes in deck cargo from that shown in the loading conditions, when the permeability of the deck cargo is significantly different from 25%
  - for ships carrying timber deck cargoes, indications of the maximum permissible amount of deck cargo
- states that criteria are laid down for ships carrying timber deck cargoes
- states the additional criteria recommended for passenger ships
- states that the information includes a curve or table giving, as a function of the draught, the required initial GM which ensures compliance with the recommendations on intact stability

Intact Stability Requirements for the Carriage of Grain

R1, R2

- states the intact stability requirements for the carriage of grain
- states that before loading bulk grain the master may be required to demonstrate that the ship will comply with the stability criteria at all stages of the voyage
- states that the ship must be upright before proceeding to sea
- states that grain loading information includes:
  - curves or tables of grain heeling moments for every compartment, whether filled or partly filled
  - tables of maximum permissible heeling moments or other information sufficient to allow the master to demonstrate compliance with the requirements
  - details of the requirements for temporary fittings and the provisions for the bundling of bulk grain
  - typical loaded service departure and arrival conditions and, where necessary, intermediate worst service conditions
  - a worked example for the guidance of the master
  - loading instructions in the form of notes summarizing the requirements of SOLAS, chapter VI
- explains what are volumetric heeling moments
- states that heeling moment = $\dfrac{\text{volumetric heeling moment}}{\text{stowage factor}}$
- states how the vertical shift of grain surfaces is taken into account in filled compartments and in partly filled compartments
- calculates the heeling arm, λ_O, from:

$$\lambda_O = \frac{\text{Volumetric heeling moment}}{\text{stowage factor x displacement}}$$

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

- draws the heeling-arm curve on the righting-arm curve for a given ship and KG, corrected for free surface liquid, and:
  - determines the angle of heel
  - using Simpson's rules, calculates the residual dynamical stability to the angle laid down by Regulation 4 of SOLAS chapter VI — R2
- compares the results of the calculations in the above objective with the criteria set out in Regulation 4 and states whether the ship complies with the requirements or does not comply

Rolling of Ships — R1

- describes the effect on GM of rolling
- explains how increase of draught and of displacement influence rolling
- describes how the distribution of mass within the ship affects the rolling period
- explains what synchronization is and the circumstances in which it is most likely to occur
- describes the actions to take if synchronization is experienced
- describes how bilge keels, anti-rolling tanks and stabilizer fins reduce the amplitude of rolling
- states that a ship generally heels when turning
- states that, while turning, the ship is subject to an acceleration towards the centre of the turn
- states that the force producing the acceleration acts at the underwater centre of lateral resistance, which is situated at about half-draught above the keel
- states that the force in the above objective is called the centripetal force, given by $F = \frac{Mv^2}{r}$

  where: M = mass of the ship in tonnes
  v = speed in metres per second
  r = radius of turn in metres
  F = centripetal force in kilonewtons

- explains how the force acting at the centre of lateral resistance can be replaced by an equal force acting through the centre of gravity and a heeling couple equal to the force x vertical separation between the centre of lateral resistance and the centre of gravity,
  $\frac{Mv^2}{r}\left[KG - \frac{d}{2}\right]\text{Cos } \theta$
- states that the ship will heel until the resulting righting moment equals the heeling couple, i.e.

  $$M \times g \times GM \sin \theta = \frac{Mv^2}{r}\left[KG - \frac{d}{2}\right]\text{Cos } \theta$$

  where: g = acceleration due to gravity
  θ = angle of heel

- given the relevant data, calculates the angle of heel from

  $$\tan \theta = \frac{v^2\left[KG - \frac{d}{2}\right]}{g \times GM \times r}$$

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

Dry-docking and Grounding

R1

- states that for dry-docking a ship should:
  - have adequate initial metacentric height
  - be upright
  - have a small or moderate trim, normally by the stern
- states that part of the weight is taken by the blocks as soon as the ship touches, reducing the buoyancy force by the same amount
- states that the upthrust at the stern causes a virtual loss of metacentric height
- explains why the GM must remain positive until the critical instant at which the ship takes the blocks overall
- derives the formula for the upthrust at the stern

$$P = \frac{MCT \times t}{L}$$

where: P = upthrust at the stern in tonnes
t = change of trim in cm
L = distance of the centre of flotation from aft

- explains that a ship with a large trim will develop a large upthrust, which may damage the stern frame, trip the blocks or lead to an unstable condition before taking the blocks overall
- by taking moments about the centre of buoyancy, shows that, for a small angle of heel, θ,

  righting moment = $\Delta \times GM \sin\theta - P \times KM \sin\theta$

  where GM is the initial metacentric height when afloat
- shows that the righting lever is that for the ship with its metacentric height reduced by $\frac{P \times KM}{\Delta}$
- by using the equation in the above objective and KM + KG + GM, shows that righting moment = $(\Delta - P) \times GM \sin\theta - P \times KG \sin\theta$
- shows that the righting lever is that for a ship of displacement $(\Delta - P)$ and with metacentric height reduced by $\frac{P \times KG}{\Delta - P}$
- explains that the righting moment remains positive providing $\Delta \times GM$ is greater than $P \times KM$ or equivalently, $(\Delta - P) \times GM$ is greater than $P \times KG$
- calculates the minimum GM to ensure that the ship remains stable at the point of taking the blocks overall
- calculates the maximum trim to ensure that the ship remains stable on taking the blocks overall for a given GM
- calculates the virtual loss of GM and the draughts of the ship after the after level has fallen by a stated amount
- calculates the draughts on taking the blocks overall
- explains that the stability of a ship aground at one point on the centre line is reduced in the same way as in dry-docking
- states that when grounding occurs at an off-centre point, the upthrust causes heel as well as trim and reduction of GM

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

- explains that the increase in upthrust as the tide falls increases the heeling moment and reduces the stability

Shear Force, Bending Moments and Torsional Stress — R1

- explains what is meant by shearing stress
- states that the shear force at a given point of a simply supported beam is equal to the algebraic sum of the forces to one side of that point
- explains that, for a beam in equilibrium, the sum of forces to one side of a point is equal to the sum of the forces on the other side with the sign reversed
- explains what is meant by a bending moment
- states that the bending moment at a given point of a beam is the algebraic sum of the moment of force acting to one side of that point
- states that the bending moment measured to opposite sides of a point are numerically equal but opposite in sense
- draws a diagram of shear force and bending moment for simply supported beams
- states that the bending moment at any given point is equal to the area under the shear-force curve to that point
- uses the above objective to show that the bending-moment curve has a turning point where the shear force has zero value
- explains that shear forces and bending moments arise from differences between weight and buoyancy per unit length of the ship
- states that the differences between buoyancy and weight is called the load
- draws a load curve from a given buoyancy curve and weight curve
- states that the shear force at any given point is equal to the area under the load curve between the origin and that point
- draws a diagram of shear force and bending moment for a given distribution of weight for a box-shaped vessel
- explains how wave profile affects the shear-force curve and bending-moment curve
- states that each ship above a specified length is required to carry a loading manual, in which are set out acceptable loading patterns to keep shear forces and bending moments within acceptable limits
- states that the classification society may also require a ship to carry an approved means of calculating shear forces and bending moment at stipulated stations
- demonstrates the use of a loading instrument
- states that the loading manual and instrument, where provided, should be used to ensure that shear forces and bending moments do not exceed the permissible limits in still water during cargo and ballast handling
- explains what is meant by a torsional stress

COMPETENCE 3.1	**Control Trim, Stability and Stress**	**IMO Reference**

- describes how torsional stresses in the hull are set up
- states that wave-induced torsional stresses are allowed for in the design of the ship
- states that cargo-induced torsional stresses are a problem mainly in container ships
- states that classification societies specify maximum permissible torsional moments at a number of specified cargo bays
- given details of loading, calculates cumulative torsional moments for stated positions
- describes the likelihood of overstressing the hull structure when loading certain bulk cargoes

3.1.2 EFFECT ON TRIM AND STABILITY IN THE EVENT OF DAMAGE AND FLOODING

Textbooks: T11
Teaching aids: A1

Required performance:

2.1 Effect of Flooding on Transverse Stability and Trim (9 hours) R1

- states that, in the absence of hull damage, the stability is calculated in the usual way, using the added mass and making allowance for free surface liquid
- states that free surface moments for any compartment that is flooded by salt water can be approximated by

  moment = length x (breadth)^3 x 1.025/12
- states that virtual loss of GM = $\frac{\text{moment}}{\text{flooded displacement}}$
- states that when a compartment is holed the ship will sink deeper in the water until the intact volume displaces water equivalent to the mass of the ship and its contents
- explains that the loss of buoyancy of a holed compartment is equal to the mass of water which enters the compartment up to the original waterline
- states that the volume of lost buoyancy for a loaded compartment is equal to the volume of the compartment x the permeability of the compartment
- calculates the permeability of cargo, given its density and its stowage factor
- states that if the lost buoyancy is greater than the reserve buoyancy the ship will sink
- states that the centre of buoyancy moves to the centre of immersed volume of the intact portion of the ship
- states that when a compartment is hold the ship's displacement and its centre of gravity are unchanged
- explains that a heeling arm is produced, equal to the transverse separation of G and the new position of B for the upright ship

COMPETENCE 3.1 Control Trim, Stability and Stress **IMO Reference**

- states that the area of intact waterplane is reduced by the area of the flooded spaces at the level of the flooded waterline multiplied by the permeability of the space

- states that if the flooded space is entirely below the waterline there is no reduction in intact waterplane

- calculates the increase in mean draught of a ship, given the TPC and the dimensions of the flooded space, using

  $$\text{increase in draught} = \frac{\text{volume of lost buoyancy}}{\text{area of intact waterplane}}$$

- states that the height of the centre of buoyancy above the keel increases by about half the increase in draught due to flooding

- states that a reduction in waterplane area leads to a reduction in the second moment of area (I)

- uses the formula $BM = \frac{I}{V}$ to explain why the BM of a ship is generally less when bilged that when intact

- states that change in GM is the net result of changes in KB and BM

- explains why the GM usually decreases where:
  - there is a large loss of intact waterplane
  - there is intact buoyancy below the flooded space
  - the flooded surface has a high permeability

- explains why the bilging of empty double-bottom tanks or of deep tanks that are wholly below the waterline leads to an increase in GM

- calculates the reduction in BM resulting from lost area of the waterplane, given the following corrections:
  - second moment of lost area about its centroid/displaced volume;

    this is $\frac{Lb^3}{12V}$ for a rectangular surface

    where: L is length of the lost area
    b is breadth of the lost area
    V is displaced volume $= \frac{\text{displacement}}{\text{density of water}}$

- $- \frac{\text{original waterplane area}}{\text{intact waterplane area}} \times \text{lost area} \times \frac{(\text{distance from centreline})^2}{\text{displaced volume}}$

  this is $\frac{\text{original waterplane area}}{\text{intact waterplane area}} \times 1bd^2/V$

  for a rectangular surface, where d is the distance of the centre of the area from the centreline

- deduces that the second correction applies only in the case of asymmetrical flooding

- calculates the shift (F) of the centre of flotation (CF) from the centreline, using

  $$F = \frac{a \times d}{A - a}$$

  where: a is the lost area of waterplane
  A is the original waterplane area
  d is the distance of the centre of lost area of waterplane from the centreline

- shows that the heeling arm is given by

$$\text{heeling arm} = \frac{\text{lost buoyancy (tonnes)}}{\text{displacement}} \times \text{transverse distance from new CF}$$

- constructs a GZ curve for the estimated GM and superimposes the heeling-arm curve to determine the approximate angle of heel
- uses wall sided formula to determine GZ values
- uses wall sided formula to calculate angle of heel
- states that, for small angles of heel, θ,

$$\tan\theta = \frac{\text{heeling arm}}{\text{GM}}$$

- explains how lost area of waterplane affects the position of the centre of flotation

Effect of Flooding on Trim

- calculates the movement of the centre of flotation (CF), given:

$$\text{Movement of CF} = \frac{\text{moment of lost area about original CF}}{\text{intact waterplane area}}$$

- explains how the reduction in intact waterplane reduces the MCT 1cm
- calculates the reduction of BML , given the following corrections:
  – second moment of lost area about its centroid/displaced volume;

  this is $\frac{bL^3}{12V}$ for a rectangular surface

  where: L is length of lost area
  B is breadth of lost area
  V is displaced volume $= \frac{\text{displacement}}{\text{density of water}}$

  $- \frac{\text{original waterplane area}}{\text{intact waterplane area}} \times \text{lost area} \times \frac{(\text{distance from CF})^2}{\text{displaced volume}}$

  this is $\frac{\text{original waterplane area}}{\text{intact waterplane area}} \times bld^2/v$

  – for a rectangular surface, where d is the distance of the centre of area from the original centre of flotation

- calculates the reduction of MCT 1cm, given,

$$\text{reduction of MCT 1cm} = \frac{\text{displacement} \times \text{reduction of GM}}{100 \times \text{ship's length}}$$

- states that the trimming moment is calculated from:

  trimming moment = lost buoyancy x distance from new CF

  where the lost buoyancy is measured in tonnes

- given the dimensions of a bilged space and the ship's hydrostatic data, calculates the draughts in the damaged condition
- describes measures which may be taken to improve the stability or trim of a damaged ship

COMPETENCE 3.1	Control Trim, Stability and Stress	IMO Reference

2.2 Theories Affecting Trim and Stability (2 hours) R1

- describes the effects on centre of gravity of slack tanks
- identifies free surface moments and shows its application to dead-weight moment curves
- interprets changes in stability which take place during a voyage
- describes effect on stability of ice formation on super structure
- describes the effect of water absorption by deck cargo and retention of water on deck
- describes stability requirements for dry docking R1
- demonstrates understanding of angle of loll
- states precautions to be observed in correction of angle of loll
- explains the dangers to a vessel at an angle of loll
- describes effects of wind and waves on ships stability
- lists the main factors which affect the rolling period of a vessel
- explains the term synchronous rolling and describes the dangers associated with it
- describes the actions that can be taken to stop synchronous rolling

3.1.3 IMO RECOMMENDATIONS CONCERNING SHIP STABILITY

Textbooks:
Teaching aids: A1

Required performance:

3.1 Responsibilities under the International Conventions and Codes (2 hours)

- states minimum stability requirements required by Load Line Rules 1966 R1, R2
- demonstrates correct use of IMO Grain Regulations
- explains how grain healing moment information is used
- describes the requirements for passenger ship stability after damage R2
- explains how the effects of steady and gusting winds are determined
- states the minimum IMO stability requirements with respect to wind heeling under current regulations R6

COMPETENCE 3.2	**Control Trim, Stability and Stress**	**IMO Reference**

TRAINING OUTCOME:

Demonstrates a knowledge and understanding of:

3.2.1 INTERNATIONAL MARITIME LAW EMBODIED IN INTERNATIONAL AGREEMENTS AND CONVENTIONS, WITH PARTICULAR REGARD TO CERTIFICATES AND DOCUMENTS TO BE CARRIED ON BOARD BY INTERNATIONAL CONVENTIONS; RESPONSIBILITIES UNDER THE RELEVANT REQUIREMENTS OF THE INTERNATIONAL CONVENTION ON LOAD LINES, SAFETY OF LIFE AT SEA, PREVENTION OF POLLUTION FROM SHIPS, AND METHODS OF AID TO PREVENT POLLUTION OF THE MARINE ENVIRONMENT ; REQUIREMENTS OF THE INTERNATIONAL HEALTH REGULATIONS; AND NATIONAL LEGISLATION FOR IMPLEMENTING INTERNATIONAL AGREEMENTS AND CONVENTIONS	STCW Code Table A-II/2

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

3.2.1 INTERNATIONAL MARITIME LAW EMBODIED IN INTERNATIONAL CONVENTIONS

Textbooks: T19
Teaching aids: A1, V3, V5, V6, V7, V8

Required performance:

1.1 Certificates and Other Documents Required to be Carried on Board Ships by International Conventions (1 hour)

- lists the following certificates and states their periods of validity:
  - Certificate of Nationality (the ship's register)
  - International Tonnage Certificate
  - (Panama and Suez Canal Tonnage Certificates)
  - International Load Line Certificate (1966)
  - Passenger Ship Safety Certificate
  - Cargo Ship Safety Construction Certificate
  - Cargo Ship Safety Equipment Certificate
  - Cargo Ship Safety Radiotelegraph Certificate
  - Cargo Ship Safety Radiotelephony Certificate
  - International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk
  - International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk
  - International Oil Pollution Prevention Certificate
  - International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk
  - International Sewage Pollution Prevention Certificate (1973)
  - Certificate of financial security required under the International Convention on Civil Liability for Oil Pollution Damage, 1969
  - Special Trade Passenger Ship Safety Certificate
  - Special Trade Passenger Ship Space Certificate
  - Exemption certificates, where applicable
  - register of, and certificates for, cargo-handling appliances
  - licence (s) for the ship radio station
  - INMARSAT access authorization certificate

- lists the following documents which should be available on board:
  - Classification Society Certificates for Hull and Machinery, and where appropriate, Refrigerating Machinery and Cargo-handling Appliances
  - Anchor and Chain Cable Certificate
  - Inflatable Liferaft Inspection Certificates
  - Stability, Loading and Ballasting Information
  - Damage Control Plan and Booklets
  - Document of Authorization for Grain Loading
  - Oil Record Book
  - Official Log-book; Deck, Engine-room and Radio Log-books
  - Articles of Agreement with the Crew
  - Seamen's Discharge Books
  - Certificates for Competency of Officers and Ratings
  - Minimum Safe Manning Document
  - Safety Management Certificate
  - copy of the owner's or manager's Document of Compliance

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- lists as minimum additional documents required at arrival or departure:
  - general declaration
  - cargo declaration
  - dangerous goods manifest or plan
  - ship's stores declaration
  - crew's effects declaration
  - crew list
  - passenger list
  - Deratting or Deratting Exemption Certificate
  - Maritime Declaration of Health

1.2 Responsibilities under the Relevant Requirements of the International Convention on Load Lines (1 hour)

- states that, after repairs or alterations, a ship should comply with at least the requirements previously applicable and that, after major repairs or alterations, ships should comply with the requirements for a new ship in so far as the Administration deems reasonable and practicable

the

- states that a ship to which the Convention applies must comply with the requirements for that ship in the zones and areas described in Annex II, as amended
- explains the treatment of a port lying on the boundary between two zones or areas
- states that the appropriate load lines on the sides of the ship corresponding to the season and to the zone or area in which the ship may be must not be submerged at any time when the ship puts to sea, during the voyage or on

arrival

- states that when a ship is in fresh water of unit density the appropriate load line may be submerged by the amount of the fresh water allowance shown on the International Load Line Certificate (1966)
- states that when a ship departs from port situated on a river or inland waters, deeper loading is permitted corresponding to the weight of fuel and all other materials required for consumption between the point of departure and the sea
- describes the requirements for initial and periodical surveys
- describes the requirements for periodical inspections and lists the fittings and appliances which are inspected
- states that the periodical inspections should be endorsed on the International Load Line Certificate (1966)
- states that after any survey has been completed no change should be made in the structure, equipment or other matters covered by the survey without the sanction of the Administration
- states that an International Load Line Certificate (1966) should be issued to every ship which has been surveyed and marked in accordance with the Convention or an International Load Line Exemption Certificate should be issued to a ship which has been granted exemption
- explains the circumstances in which an International Load Line Certificate (1966) would be cancelled by the Administration
- describes the information which should be supplied to the master concerning the loading and ballasting of the ship and its stability under varying conditions of service

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- describes the contents of the record of conditions of assignment which should be supplied to the ship

1.3 Responsibilities under the Relevant Requirements of the International Convention for the Safety of Life at Sea (2 hours) R2

- states the obligations of the master concerning the sending of danger messages relating to dangerous ice, a dangerous derelict, other dangers to navigation, tropical storms, sub-freezing air temperature with gale force winds causing severe ice accretion or winds of force 10 or above for which no storm warning has been received
- lists the information required in danger messages
- states that when ice is reported near his course, the master of every ship at night is bound to proceed at a moderate speed or to alter his course so as to go well clear of the danger zone
- states that the use of an international distress signal, except for the purpose of indicating that a ship or aircraft is in distress, and the use of any signal which may be confused with an international distress signal are prohibited
- states the obligations of the master of a ship at sea on receiving a signal from any source that a ship or aircraft or a survival craft thereof is in distress R2 Ch.V Reg.10
- explains the rights of the master of a ship in distress to requisition one or more ships which have answered his call for assistance
- explains when the master of a ship is released from the obligation to render assistance
- describes the requirements for the carriage of navigational equipment
- states that all equipment fitted in compliance with Reg. V/12 must be of a type approved by the Administration
- states that all ships should be sufficiently and efficiently manned
- states that manning is subject to Port State Control inspection
- lists the contents of the minimum safe manning document referred to in Assembly resolution A.481(XII), Principles of Safe Manning
- states that in areas where navigation demands special caution, ships should have more than one steering gear power unit in operation when such units are capable of simultaneous operation R2
- describes the procedure for the testing of the ship's steering gear before departure
- describes the requirements for the display of operating instructions and change-over procedures for remote steering gear control and steering gear power units
- describes the requirements for emergency steering drills
- lists the entries which should be made in the log-book regarding the checks and tests of the steering gear and the holding of emergency drills
- states that all ships should carry adequate and up-to-date charts, sailing directions, lists of lights, notices to mariners, tide tables and other nautical publications necessary for the voyage

COMPETENCE 3.2	**Monitor and Control Compliance with Legislative Requirements**	**IMO Reference**

- states which ships should carry the International Code of Signals

1.4 Responsibilities under the International Convention for the Prevention of Pollution from Ships, 1973, and the Protocol of 1978 relating thereto (MARPOL 73/78) (3 hours)

- explains who may cause proceedings to be taken when a violation occurs within the jurisdiction of a Party to the Convention
- explains the Parties to the Convention must apply the requirements of the Convention to ships of non-Parties to ensure that no more favourable treatment is given to such ships

Annex I – Oil — R18

- states that, after survey has been completed, no change should be made in the structure, equipment, fittings, arrangements or materials without the sanction of the Administration, except the direct replacement of equipment and fittings
- explains the master's duty to report when an accident occurs or a defect is discovered which substantially affects the integrity of the ship or the efficiency or completeness of its equipment covered by this Annex
- states that the dates of intermediate and annual surveys are endorsed on the IOPP Certificate
- states that a record of construction and equipment is attached as a supplement to the IOPP Certificate
- explains the duration of validity of the IOPP Certificate and the circumstances in which the IOPP Certificate will cease to be valid
- states that all new crude oil tankers of 20,000 tonnes deadweight and above must be fitted with a crude oil washing system
- states that the competent authority of the Government of a Party to the Convention may inspect the Oil Record Book while the ship is in its port or offshore terminals and may make a copy of any entry and may require the master to certify that the copy is a true copy of such entry
- states that a copy certified by the master is admissible in any judicial proceedings as evidence of the facts stated in the entry
- states that the master should be provided with information relative to loading and distribution of cargo necessary to ensure compliance with the regulation on subdivision and stability and the ability of the ship to comply with the damage stability criteria
- states all ships of 400gt or more must carry an approved shipboard oil pollution emergency plan (SOPEP)

Annex II – Noxious Liquid Substances in Bulk — R19

- states the duration of validity of the certificate
- explains that ships which have been surveyed and certified in accordance with the International Bulk Chemical Code (IBC Code) or the Bulk Chemical Code (BCH Code), as applicable, are deemed to have complied with the regulations regarding survey and certification and do not require to have an International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

Annex III – Harmful Substances Carried by Sea in Packaged Forms, or in Freight Containers, Portable Tanks or Tank Wagons

- states that the master of the ship, or his representative, should notify the appropriate port authority of the intention to load or unload certain harmful substances at least 24 hours in advance

Annex IV – Sewage

- defines, for the purposes of Annex IV:
  – holding tank, sewage and nearest land
- states the ships to which the provisions apply
- states that ships to which the regulations apply are subject to surveys for the issue of an International Sewage Pollution Prevention Certificate (1973)
- states the duration of validity of the certificate

Annex V – Garbage

- explains that when garbage is mixed with other discharges having different disposal requirements, the more stringent requirements apply
- describes the provisions for disposal of garbage from off-shore platforms and from ships alongside or within 500 metres from them
- lists the special areas for the purposes of this annex
- explains the requirements for disposal of garbage within special areas
- describes the exceptions to regulations 3, 4 and 5
- describes the form of record keeping required
- states records are subject to scrutiny by port state control officers

1.5 Maritime Declarations of Health and the Requirements of the International Health Regulations

Arrival Documents and Procedures (4 hours)
International Health Regulations (1969) as amended (IHR) — R34

- defines for the purposes of these regulations:
  – arrival of a ship
  – baggage
  – container or freight container
  – crew
  – diseases subject to the Regulations
  – disinsecting
  – epidemic
  – free pratique
  – health administration
  – health authority
  – infected person
  – in quarantine
  – international voyage
  – isolation
  – medical examination

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- ship
- suspect
- valid certificate

- states that a health authority should, if requested, issue, free of charge to the carrier, a certificate specifying the measures applied to a ship or container, the parts treated, methods used and the reasons why they have been applied
- states that, except in an emergency constituting a grave danger to public health, a ship which is not infected or suspected of being infected with a disease subject to the Regulations should not be refused free pratique on account of any other epidemic disease and should not be prevented from discharging or loading cargo or stores, or taking on fuel or water
- states that a health authority may take all practicable measures to control the discharge from any ship of sewage and refuse which might contaminate the waters of a port, river or canal
- describes the measures which the health authority of a port may take with respect to departing travellers
- states that no health measures should be applied by a State to any ship which passes through waters within its jurisdiction without calling at a port or on the coast
- describes the measures which may be applied to a ship which passes through a canal or waterway in a territory of a State on its way to a port in the territory of another State
- states that, whenever possible, States should authorize granting of free pratique by radio
- explains that the master should make known to port authorities, as long as possible before arrival, any case of illness on board, in the interests of the patient and the health authorities and to facilitate clearance of the ship
- states that, on arrival of a ship, an infected person may be removed and isolated and that such removal should be compulsory if required by the master
- states that a ship should not be prevented for health reasons from calling at any port, but if the port is not equipped for applying the health measures which in the opinion of the health authority of the port are required, the ship may be ordered to proceed at its own risk to the nearest suitable port convenient to it
- explains the actions open to a ship which is unwilling to submit to the measures required by the health authority of a port
- describes the measures concerning cargo and goods
- describes the measures concerning baggage

Plague

- states that, for the purposes of the Regulations, the incubation period of plague is six days
- states that vaccination against plague should not be required as a condition of admission of any person to a territory
- states that during the stay of a ship in a port. infected by plague. special care should be taken to prevent the introduction of rodents on board
- states that ships should be permanently kept free of rodents and the plague vector or be periodically deratted

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- describes the requirements for the issue of a Deratting Certificate or a Deratting Exemption Certificate and states their periods of validity
- states the conditions in which a ship on arrival is to be regarded as infected, suspected or healthy
- describes the measures which may be applied by a health authority on the arrival of an infected or suspected ship
- describes the measures which may be applied by a health authority on the arrival of a healthy ship from an infected area

Cholera

- states that, for the purposes of the Regulations, the incubation period of cholera is five days
- describes the measures to be taken by the health authority if a case of cholera is discovered upon arrival or a case has occurred on board

Yellow Fever

- states that, for the purposes of the Regulations, the incubation period of yellow fever is six days
- states that vaccination against yellow fever may be required of any person leaving an infected area on an international voyage
- states that every member of the crew of a ship using a port in an infected area must be in possession of a valid certificate of vaccination against yellow fever
- states the conditions in which a ship on arrival is to be regarded as infected, suspected or healthy
- describes the measures which may be applied by a health authority on the arrival of an infected or suspected ship

Documents

- states that bills of health or any other certificates concerning health conditions of a port are not require from any ship
- describes the master's obligations concerning a Maritime Declaration of Health
- states that the master and the ship's surgeon, if one is carried, must supply any information required by the health authority as to health conditions on board during the voyage
- states that no health document, other than those provided for in the Regulations, should be required in international traffic

Convention on Facilitation of International Maritime Traffic, 1965, as amended (FAL 1965)

- states that the purpose of the Convention is to facilitate maritime transport by simplifying and reducing to a minimum the formalities, documentary requirements and procedures on the arrival, stay and departure of ships engaged in international voyages
- explains that the Convention lays down 'standards' and 'recommended practices' regarding documentation and procedures for facilitating international maritime traffic

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- lists the documents which should be the only ones required by public authorities for their retention on arrival or departure of ships to which the Convention applies
- explains that the provisions do not preclude the requirement for the presentation for inspection by the appropriate authorities of certificates and other papers concerned with registry, measurement, safety, manning and other related matters
- states that IMO has produced standard forms for:
  - general declaration
  - cargo declaration
  - ship's effects declaration
  - crew's effects declaration
  - crew list
  - passenger list
- explains that arrival procedures may be expedited by:
  - providing the public authorities concerned with an advance message giving the best ETA, followed by any information as to change of time, and stating the itinerary of the voyage
  - having ship's documents ready for prompt review
  - rigging a means of boarding while the ship is en route to the berth or anchorage
  - providing for prompt, orderly assembling and presentation of persons on board, with necessary documents for inspection, including arrangements for relieving crew members from essential duties

Noting Protests

- explains that a 'note of protest' is a declaration by the master of circumstances beyond his control which may give, or may have given, rise to loss or damage
- states that protests are made before a notary public, magistrate, consular officer or other authority
- states that protests should be noted as soon as possible, and in any case, within 24 hours of arrival in port
- states that, at the time of noting protest, the master should reserve the right to extend it
- states that protests concerning cargo damage should be made before starting to unload
- explains that, although there is no requirement to use a special form, it is usual to do so
- explains that statements under oath are taken from the master and other members of the crew and that such statements must be supported by appropriate entries in the log-book, which must be produced
- states that certified copes of the note of protest should be forwarded to the owners and one copy retained on board
- explains why protest should be noted at each discharging port and not just at the first port of call
- states that a note of protest is advisable when:
  - during the voyage the ship has experienced weather conditions which may result in damage to cargo
  - the ship is in any way damaged, or there is reason to suspect that damage may have occurred
  - normal ventilation of perishable cargo has not been practicable on account of weather

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

– cargo is shipped in such a condition that it is likely to deteriorate during the voyage (bills of lading must be appropriately endorsed)
– the charterer or his agent commits any serious breach of the terms of the charter party
– consignees fail to discharge cargo, take delivery or pay freight in accordance with the terms of a charter party or bill of lading
– any general average act has occurred

- states that, in cases where damage is found to have occurred, it is necessary to extend protest to support claims
- states that the master should consult his owner's agent about the local requirement and practice for extending a protest
- states that the master must normally appear in person accompanied by a number, depending upon local custom, of crew members as witnesses

1.6 Responsibilities under International Instruments affecting the Safety of the Ship, Passengers, Crew and Cargo (23 hours) R33

Convention Concerning Minimum Standards in Merchant Ships, 1976 (No.147)

- states that, except as otherwise provided, the Convention applies to every sea-going ship engaged in the transport of cargo or passengers
- states that national laws or regulations should determine when ships are to be regarded as sea-going ships
- describes the undertaking of each Member which ratifies the Convention to have laws or regulations laying down safety standards, hours of work, manning and social security measures
- states that national laws and regulations should also be laid down regarding shipboard conditions of employment and shipboard living arrangements
- states that adequate procedures, subject to supervision by the competent authority after tripartite consultation amongst that authority and representative organizations of shipowners and seafarers, should exist for the engagement of seafarers in its territory and for the investigation of complaints in that connection
- states that a reporting procedure should be established for dealing with certain complaints
- explains that a Member undertakes to verify by inspection or other appropriate means that ships in its registry comply with ILO conventions in force which it has ratified
- states the undertaking to hold an official inquiry into any serious marine casualty involving ships registered in its territory, particularly those involving injury or loss of life
- explains the procedure which may be followed by a Member which has ratified the Convention on receiving a complaint or obtaining evidence that a visiting ship does not conform to the standards of this Convention
- states that the ship should not be unreasonably detained or delayed

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- defines the term 'complaint' for the purpose of Article 4

* ## Convention Concerning Seamen's Articles of Agreement, 1926 (No.22)

  - states that the Convention applies to all sea-going vessels registered in the country of any Member and to the owners, masters and seamen of such vessels
  - defines, for the purpose of the Convention:
    - vessel
    - seaman
    - master
    - home trade vessel
  - states that the articles of agreement should be signed both by the shipowner or his representative and by the seaman, who should be given reasonable facilities to examine them before signing
  - states that the seaman should sign the agreement under conditions prescribed by national law and adequate supervision by the competent authority
  - states that the prescribed conditions should be deemed to have been fulfilled if the competent authority certifies that the provisions of the agreement have been laid before it in writing and have been confirmed both by the shipowner of his representative and the seaman
  - states that national law should make adequate provision to ensure that the seaman has understood the agreement
  - states that the agreement should contain nothing contrary to national law or the provisions of the present Convention
  - states that the agreement should not contain any stipulation by which the parties purport to contract in advance to depart from the ordinary rules as to jurisdiction over the agreement
  - states that every seaman should be given a statement containing a record of his employment on board the vessel
  - states that the form of the document and the particulars to be entered in it should be determined by national law, but it should not contain any statement as to the quality of the seaman's work or as to his wages
  - states that the agreement may be made either for a definite period or for a voyage or, if permitted by law, for an indefinite period
  - states that the agreement should state clearly the respective rights and obligations of each of the parties
  - lists the particulars which the articles of agreement should in all cases contain
  - explains the procedure for the termination of an agreement for an indefinite period by either party
  - lists the circumstances in which an agreement is duly terminated
  - states that the circumstances in which the owner or master may immediately discharge a seaman are determined by national law
  - states that the circumstances in which the seaman may demand his immediate discharge are determined by national law

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- describes certain social and welfare cases in which a seaman may claim his discharge
- states that the seaman in such cases is entitled to his wages up to the time of leaving his employment
- explains that whatever the reason for the termination of the agreement, an entry should be made in the document issued to the seaman in accordance with Article 5 and, at the request of either party, be endorsed by the competent public authority
- states that a seaman has a right, in addition to the record mentioned above to obtain from the master a separate certificate as to the quality of his work or, failing that, a certificate indicating whether he has fully discharged his obligations under the agreement

Convention Fixing the Minimum Age for the Admission of Children to Employment at Sea (Revised 1936) (No.58) R33

- states that children under the age of fifteen years shall not be employed or work on vessels, other than vessels upon which only members of the same family are employed
- states that in order to facilitate the enforcement of the provisions of the Convention, every ship master is required to keep a record of all persons under the age of sixteen years employed on board his vessel, or a list of them in the articles of agreement, and of the dates of their births

Convention Concerning Minimum Age for Admission to Employment, 1973 (No.138) R33

- explains that each Member for which this Convention is in force undertakes to pursue a national policy designed to ensure the effective abolition of child labour and to raise progressively the minimum age for admission to employment or work to a level consistent with the fullest physical and mental development of young persons
- states that each Member which ratifies this Convention must specify a minimum age for admission to employment which in any case should not be less than fifteen years
- explains that national laws or regulations should prescribe the registers to be kept by the employer of persons whom he employs and who are less than 18 years of age

Convention Concerning Certification of Ships' Cooks, 1946 (No.69) R33

- explains the scope of application
- defines the term 'ship's cook'
- explains that no person may be engaged as ship's cook on board any vessel unless he holds a certificate of qualification as a ship's cook granted in accordance with the provisions of the present Convention
- states that the competent authority should make specified arrangements for the holding of examinations and for the granting of certificates of qualification

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

Convention Concerning the Certification of Able Seamen, 1946 (No. 74) — R33

- explains that no person, other than a person who by national laws or regulations is deemed to be competent to perform any duty which may be required of a member of the crew serving in the deck department, shall be engaged on any vessel as an able seaman unless he holds a certificate of qualification as able seaman granted under the present Convention
- explains that the competent authorities should make specified arrangements for holding examinations and for the granting of certificates of qualification
- states that the prescribed minimum age of an able seaman is to be not less than eighteen years
- explains that the prescribed minimum period of service at sea is thirty-six months, but that it may be reduced in respect of approved training
- states that the prescribed examination should provide a practical test of the candidate's knowledge of seamanship and of his ability to carry out all the duties that may be requested of an able seaman, including those of a lifeboat man

Recommendation Concerning Vocational Training of Seafarers (Recommendation No.137) — R33

- explains that the Vocational Training (Seafarers) Recommendation, 1970 applies to all training for the performance of duties of persons in the deck, engine, radio and catering departments or general purpose crews, except fishermen
- states that the Recommendation is a comprehensive instrument containing detailed provisions on the basic objectives of training policy, the organization and co-ordination of training, the financing of training schemes for seafarers, advanced training courses and training methods
- describes the general recommendations contained in each of its various sections

Convention Concerning Wages, Hours of Work on Board Ship and Manning (Revised 1958) (No.109) — R33

- explains that the Convention lays down minimum wage rates for able seamen and normal hours of work for officers and ratings when the vessel is at sea, in port and on days of arrival and departure
- explains that the Convention allows for regulation by national laws or regulations or by collective agreements between the organizations of shipowners and seafarers concerning basic wage rates and compensation for overtime worked in excess of normal hours

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- states that time spent in:
  – work that the master deems to be necessary ad urgent for the safety of the vessel, cargo or persons on board
  – work required by the master for the purpose of giving assistance to other vessels or persons in distress
  – musters and fire, lifeboat and similar drills of the kind prescribed by the SOLAS convention
  – extra work for the purposes of customs or quarantine or other health regulations
  – normal and necessary work by officers for the determination of the ship's position and for making meteorological observations
  – extra time required for the normal relieving of watches
  is not included in normal hours or considered as overtime

- states that no person under the age of sixteen should work at night

- defines 'night' for the purpose of Article 20

- explains that every ship to which the Convention applies should be sufficiently and efficiently manned for the purposes of:
  – ensuring the safety of life at sea
  – giving effect to the provisions regarding hours of work
  – preventing excessive strain upon the crew and avoiding or minimizing as far as practicable the working of overtime

- states that efficient machinery for the investigation and settlement of complaints and disputes regarding manning should be maintained and should involve participation of representatives of organizations of shipowners and seafarers

* Convention Concerning Vacation Holidays with Pay for Seafarers (Revised 1949) (No.91) — R33

- states to whom the Convention is applicable

- describes the entitlement to paid vacation holidays

- states that no person may be required to take the vacation due to him at a port other than a port in the territory of engagement or a port in his home territory

- states that a seafarer should receive his usual remuneration for the full period of the vacation due

- states that any agreement to relinquish the right to an annual vacation holiday with pay or to forgo such a holiday is void

- explains the entitlement of a seafarer whose employment ceases before taking a vacation holiday due to him

* Convention Concerning Annual Leave with Pay for Seafarers, 1976 (No.146) — R33

- states that this Convention revises the Paid Vacations (Seafarers) Convention (Revised), 1949 and raises the minimum leave to 30 days for one year of service

- explains that, under conditions to be determined by the competent authority, service off articles and absence from work for approved maritime vocational training and other specified reasons is to be counted as part of the period of service

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- states that, in general, the annual leave with pay should be an uninterrupted period and a seafarer taking annual leave should be recalled only in cases of extreme emergency, with due notice

- states where a seafarer may be required to take annual leave due to him and the provisions which apply if a seafarer is required to take leave from a place other than that permitted

* Convention Concerning the Repatriation of Seamen, 1926 (No.23) R33

- explains the application of the Convention

- defines:
  - vessel
  - seaman
  - master
  - home trade vessel

- states the seaman's right to be repatriated

- explains when a seaman is deemed to have been repatriated

- states that expenses of repatriation are not to be a charge on the seaman if he has been left behind by reason of:
  - injury sustained in the service of the ship
  - shipwreck
  - illness not due to his own wilful act or default
  - discharge for any cause for which he cannot be held responsible

- explains the expenses of repatriation include transportation charges, accommodation and food during the journey and maintenance up to the time of his departure

- states that a seaman repatriated as a member of a crew is entitled to payment for work done during the voyage

- explains that the competent authority of the country in which the vessel is registered is responsible for supervising the repatriation of a crew member whatever may be his nationality

* Convention Concerning the Repatriation of Seafarers (Revised 1987) (No.166) R33

- describes the application of the Convention

- lists the circumstances in which a seafarer is entitled to repatriation

- states the destinations to which repatriation may be made

- summarizes the arrangements for repatriation

- explains when a seafarer is deemed to have been repatriated

* Recommendation Concerning the Repatriation of Seafarers, 1987 (Recommendation No. 174) R33

- states that, whenever a seafarer is entitled to be repatriated pursuant to the provisions of the Repatriation of Seafarers Convention (Revised), 1987, but both the shipowner and the Member in whose territory the ship is registered fail to meet their obligations to arrange for and meet the cost of repatriation, the State from which the Seafarer is to be repatriated or the State of which he or she is a national should arrange for his or her repatriation and recover the cost from the Member in whose territory the ship is registered

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

* Convention Concerning Food and Catering for Crews on Board Ship, 1946 (No.68) — R33

- explains that the purpose of the Convention is to provide for each Member State to maintain in force national legislation to secure a proper standard of food supply and catering service for the crews of its sea-going vessels and to enforce regulations concerning food and water supply, catering, the construction and equipment of galleys, and other catering department spaces, including store-rooms and refrigerated chambers

- states that laws or regulations or, in the absence of such laws and regulations, collective agreements must provide for inspection at prescribed intervals by the master, or an officer specially deputed for the purpose by him, together with a responsible member of the catering department of:
  - supplies of food and water
  - all spaces and equipment used for the storage and handling of food and water, and galley and other equipment for the preparation of meals

- states that the results of each such inspection must be recorded

* Convention Concerning Crew Accommodation On Board Ship (Revised 1949) (No. 92) — R33

- explains that the purpose of this Convention is to provide for each Member State to maintain in force national legislation to ensure compliance with the requirements of the Convention regarding planning and specifications for crew accommodation and its application to existing ships

- states that crew accommodation should be maintained in a clean and decently habitable condition and should be kept free of goods and stores not the personal property of the occupants

- states that the master, or an officer specially deputed for the purpose by him, accompanied by one or more members of the crew must inspect all crew accommodation at intervals of not more than one week

- states that the results of each such inspection must be recorded

* Convention Concerning Crew Accommodation on Board Ship, 1970 (Supplementary Provisions) (No.133) — R33

- states that, in respect of ships to which this Convention applies, the provisions of Parts II and III of the Accommodation of Crews Convention (Revised), 1949 also apply

- explains that Part II of this Convention contains revised and supplementary requirements for crew accommodation regarding rooms, mess rooms, recreation accommodation, bathrooms, water closets and facilities for washing, drying and ironing clothes

Recommendation Concerning the Contents of Medicine Chests on Board Ship (Recommendation No.105) — R33

- explains that the recommendations should apply to every vessel engaged in maritime navigation, whether there is a ship's doctor on board or not

- states that special provisions should be made for the custody, by the master or other responsible officer, of medicaments the use of which is restricted

- states that all medicine chests should contain a medical guide which is sufficiently detailed to enable persons other than a ship's doctor to administer to the needs of sick or injured person on board with and without supplementary medical advice by radio

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- states that the rules and regulations should provide for proper maintenance and care of the medicine chests and their contents and their regular inspection at intervals not normally exceeding 12 months by person authorized by the competent authority
- explains that there exists a recommended pre-arranged system for medical advice by radio to ships at sea which is available free of charge at any hour of the day or night
- explains that there is an up-to-date and complete list of radio stations from which medical advice can be obtained and that this list should be carried on each ship equipped with a radio installation

Convention Concerning the Prevention of Occupational Accidents to Seafarers, 1970 (No.134) — R33

- explains that the Convention deals mainly with the obligations of the competent authority in each maritime country to ensure that occupational accidents are prevented, adequately reported and investigated
- states that the accident-prevention provisions laid down by national legislation, codes of practice or other appropriate means should clearly specify the obligations of shipowners, seafarers and others concerned to comply with them
- states that, generally, any obligation on the shipowner to provide protective equipment or other accident-prevention safeguards should be accompanied by provision for the use of such equipment and safeguards by seafarers and a requirement that they comply with the relevant accident-prevention measures
- states that provision should be made for the appointment, from amongst the crew of the ship, of a suitable person or suitable persons or of a suitable committee responsible, under the master, for accident prevention
- states that all appropriate and practicable measures should be taken to bring to the attention of seafarers information concerning particular hazards, for instance by means of official notices containing relevant instructions

Recommendation Concerning the Prevention of Occupational Accidents to Seafarers, 1970 (Recommendation No.142) — R33

- explains that this Recommendation lists in great detail possible measures for formulating provisions to give effect to the intentions of and aims of the Convention concerning the Prevention of Occupational Accidents to Seafarers, 1970

Convention Concerning the Compulsory Medical Examination of Children and Young Persons Employed at Sea, 1921 (No.16) — R33

- defines the term 'vessel' as all ships and boats of any nature whatsoever, engaged in maritime navigation, whether publicly or privately owned, excluding ships of war
- states that the employment of any child or young person under the age of eighteen years of age on any vessel, other than vessels upon which only members of the same family are employed, is to be conditional on the production of a medical certificate attesting fitness for such work, signed by a doctor approved by the competent authority
- states that continued employment of such children or young persons is subject to the repetition of such medical examination at intervals of not more than one year

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

Convention Concerning the Medical Examination of Seafarers, 1946 (No.73) — R33

- states the scope of application as to vessels
- states the persons to whom the Convention applies
- states that no person to whom this Convention applies may be engaged for employment in a vessel to which this Convention applies unless he produces a certificate attesting to his fitness for the work for which he is to be employed at sea signed by a medical practitioner or, in the case of a certificate solely concerning his sight, by a person authorized by the competent authority to issue such a certificate
- explains that the nature of the examination should take into account the age of the person and the nature of the duties to be performed
- states that, in particular, the medical certificate should attest that the hearing and sight of a person, and where appropriate, the colour vision are all satisfactory
- states that the medical certificate should attest that the person is not suffering from any disease likely to be aggravated by, or render him unfit for, service at sea or likely to endanger the health of other persons on board
- states that the medical certificate will remain in force for a period not exceeding two years from the date on which it was granted
- states that a medical certificate relating to colour vision will remain in force for a period not exceeding six years from the date on which it was granted

Convention Concerning Health Protection and Medical Care for Seafarers, 1987 (No.164) — R33

- states that shipowners are made responsible for keeping ships in proper sanitary and hygienic conditions
- states that measures should be adopted which:
  - ensure the application to seafarers of any general provisions or occupational health protection and medical care, as well as of special provisions peculiar to work on board
  - aim at providing seafarers with health protection and medical care comparable with that generally available to workers ashore
  - guarantee seafarers the right to visit a doctor without delay in ports of call
  - ensure that medical care and health protection while a seafarer is serving on articles are provided free of charge
  - include the development of programmes of health promotion and health education
- states that every ship must carry a medicine chest, the contents of which and the medical equipment on board are to be prescribed by the competent authority, taking account of the WHO International Medical Guide for Ships and the WHO list of Essential Drugs
- states that the contents of the medicine chest are to be properly maintained and inspected at regular intervals, not exceeding 12 months, by responsible persons designated by the competent authority
- explains that, where a dangerous cargo is to be carried which has not been included in the most recent edition of the Medical First Aid Guide for Use in Accidents involving Dangerous Goods, the necessary information on the nature of the substances, the risks involved, the necessary personal protective devices, the relevant medical procedures and specific antidotes is to be made available to the master, seafarers and other interested persons

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- states that specific antidotes and personal protective devices must be on board whenever dangerous goods are carried
- states that every ship must carry a ship's medical guide adopted by the competent authority
- describes the requirements concerning medical advice by radio or satellite communications to ships at sea
- states that all ships carrying 100 or more seafarers and engaged on international voyages of more than three days' duration must carry a medical doctor as a member of the crew responsible for providing medical care
- states that ships which do not carry a doctor must carry as members of the crew one or more specified persons, who have completed an approved course in medical skills, in charge of medical care and the administering of medicines as part of their regular duties
- states that ships must provide all possible medical assistance, where practicable, to other vessels which may request it
- states that any ship of 500 or more gross tonnage, carrying 15 or more seafarers and engaged in a voyage of more than three days' duration, must be provided with separate hospital accommodation

* Convention Concerning the Liability of the Shipowner in Case of Sickness, Injury or Death of Seamen, 1936 (No.55) — R33

- states the persons to whom the Convention applies
- describes the shipowner's liabilities and possible exceptions
- defines 'medical care and maintenance at the expenses of the shipowner' in the context of this Convention
- describes the liability of the shipowner to defray the expense of medical care and maintenance of sick or injured persons
- states that the shipowner is liable to defray the expense of repatriating every sick or injured person who is landed during the voyage in consequence of sickness or injury
- states that the shipowner is liable for the burial expenses in case of death occurring on board, or in the case of death occurring on shore if at the time of his death the deceased person was entitled to medical care and maintenance at the shipowner's expense
- states that national laws or regulations must require the shipowner or his representative to take measures to safeguard property left on board by sick, injured or deceased persons
- states that the Convention applies equally to the treatment of all seamen irrespective of nationality, domicile or race

* Convention Concerning Sickness Insurance for Seamen, 1936 (No.56) — R33

- states the persons to whom a compulsory sickness insurance scheme applies
- describes the entitlement to cash benefit and medical treatment under the scheme

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- states that when the insured person is abroad and by reason of sickness has lost his right to wages, the cash benefit or part of it should be paid to his family until his return
- states that national laws should prescribe the conditions under which an insured woman is entitled to maternity benefit
- states that, on the death of an insured person, a cash benefit is payable to members of the family of the deceased to defray funeral expenses
- states that the right to insurance benefit extends to the normal interval between engagements
- states that the insured persons and their employers are to share in providing the financial resources of the sickness insurance scheme

* Convention Concerning Social Security of Seafarers (Revised 1987) (No.165) — R33

- defines, for the purpose of this Convention:
  - seafarer
  - dependant
  - survivor
  - legislation
- states that the Convention applies to all seafarers and, where applicable their dependants and survivors
- states that this Convention provides for the application of either minimum standards or superior standards in respect of at least three branches of social security listed in Article 3
- states that legislation should provide for seafarers' social security protection not less favourable than that enjoyed by shoreworkers
- states that arrangements for the maintenance of rights in the course of acquisition must be made between a scheme of compulsory social security for seafarers and as equivalent scheme for shoreworkers
- states that a shipowner is required to provide to seafarers whose condition requires medical care while on board or who are left abroad by reason of their condition:
  - proper and sufficient medical care until their recovery or until repatriation, whichever first occurs
  - board and lodging until they are able to obtain suitable employment or are repatriated, whichever first occurs
  - repatriation
- summarizes the continued entitlement to wages of seafarers who by reason of their condition are left behind abroad or repatriated
- explains that the Convention contains provisions to protect the right of foreign or migrant seafarers, their dependants and survivors to benefits enjoyed by nationals
- states that the shipowner's liability provided for in Articles 13 to 15 applies equally to seafarers irrespective of their place of residence

* Convention Concerning Seafarers' Welfare at Sea and in Port, 1987 (No.163) — R33

- defines, for the purposes of this Convention:
  - seafarer
  - welfare facilities and services

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- states that each Member for which this Convention is in force undertakes to ensure that adequate welfare facilities and services are provided for seafarers both in port and on board ship
- states that each Member undertakes to ensure that welfare facilities and services are provided for all seafarers in appropriate ports of the country
- states that each Member undertakes to ensure that the welfare facilities and services on every seagoing ship registered in its territory are provided for the benefit of all seafarers on board
- states that welfare facilities and services should be reviewed frequently to ensure that they are appropriate

* Recommendation Concerning Seafarers' Welfare at Sea and in Port, 1987 (Recommendation No.173) R33

- describes the recommendations on welfare facilities and services in ports regarding:
  - consultation with representative organizations of shipowners and seafarers
  - the provision of welfare facilities and services
  - the types of facilities and services to be provided
  - the information to be made known to seafarers entering port
- describes the recommendation on the protection of seafarers detained abroad
- states that welfare services should include practical assistance to seafarers stranded in foreign ports pending their repatriation
- describes the recommendations on welfare facilities and services at sea
- states the recommendation on the adoption of systems to help seafarers to save and to transmit their savings to their families

* Convention Concerning Freedom of Association and Protection of the Right to Organise, 1948 (No.87) R33

- states that workers and employers, without any distinction, have the right to establish and, subject only to the rules of the organization concerned, to join organizations of their own choosing
- states that workers' and employers' organizations have the right to draw up their constitutions and rules and run their organizations without interference from public authorities which would restrict this right or impede its lawful exercise
- states that workers' and employers' organisations are not to be liable to be dissolved or suspended by administrative authority
- states that, in exercising the rights provided for in this Convention, workers and employers and their respective organizations must respect the law of the land
- states that each Member undertakes to take all necessary and appropriate measures to ensure that workers and employers may exercise freely the right to organize

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

* Convention Concerning the Application of the Principles of the Right to Organise and to Bargain Collectively, 1949 (No.98) — R33

- states that workers should enjoy adequate protection against acts of anti-union discrimination in respect of their employment, particularly in respect of acts calculated to:
  - make employment of a worker subject to the condition that he shall not be a union member
  - cause the dismissal of or otherwise prejudice a worker by reason of union membership or participation in union activities outside working hours
- states that workers' and employers' organizations must enjoy adequate protection against any acts of interference by each other or each other's agents or members in their establishment, functioning or administration
- explains that appropriate measures should be taken to encourage and promote the development and use of machinery for voluntary negotiation between employers or employers' organizations and workers' organizations, with a view to regulation of terms and conditions of employment by means of collective bargaining

Collision (2 hours) — R35

International Convention for the Unification of Certain Rules of Law with Respect to Collision Between Vessels (Collision, 1910)

- states that when collision is accidental, is caused by 'force majeure' or if the cause is left in doubt, the damages are borne by those who have suffered them
- states that if collision is caused by the fault of one of the vessels, liability to make good the damage attaches to the one which committed the fault
- explains the apportionment of liability when two or more vessels are in fault
- explains that liability attaches where the collision is caused by the fault of a pilot even when the pilot is carried by compulsion of law
- describes the duties of the master after a collision
- explains that the Convention extends to the making good of damages which a vessel has caused to another vessel or to goods or persons on board either vessel, either by the execution or non-execution of a manoeuvre or by the non-observance of regulations, even if no collision has actually taken place
- states that in the event of a collision or any other incident of navigation concerning a sea-going ship and involving the penal or disciplinary responsibility of the master or any other person in the service of the ship, criminal or disciplinary proceedings may be instituted only before the judicial or administrative authorities of the State of which the ship was flying the flag at the time of the collision or other incident of navigation
- states that no arrest or detention of the vessel should be ordered, even as a measure of investigation, by any authorities other than those whose flag the ship is flying
- states that nothing in the present Convention is to prevent any State from permitting its own authorities, in case of collision or other incidents of navigation, to take any action in respect of certificates of competence or licences issued by that State or to prosecute its own nationals for offences committed while on board a ship flying the flat of another State
- states that the Convention does not apply to collisions or other incidents of navigation occurring within the limits of a port or in inland waters and that the High Contracting Parties are at liberty to reserve to themselves the right to take proceedings in respect of offences committed within their own territorial waters

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

Assistance and Salvage (2 hours) R56

International Convention on Salvage, 1989 (The London Salvage Convention)

- defines 'salvage operation', 'vessel' and 'property'
- describes the 'no cure – no pay' principle
- describes the application of the Convention
- describes the duties of the salvor, of the owner and of the master
- describes the rights of salvors
- states the criteria for assessing a reward
- states the criteria for assessing Special Compensation
- explains that the apportionment of the remuneration amongst the owners, master and other persons in the service of each salving vessel is to be determined by the law of the vessel's flag
- explains that every agreement as to assistance or salvage entered into at the moment and under the influence of danger may, at the request of either party, be annulled, or modified by the court, if it considers that the conditions agreed upon are not equitable
- describes the reasons for the court to set aside the agreed remuneration in whole or in part (salvor's fault, neglect, fraud or dishonesty)
- states that no remuneration is due from persons whose lives are saved except as provided in national law
- describes the rights of salvors of human life who have taken part in the salvage operations
- states that every master is bound, so far as he can do so without serious danger to his vessel, her crew and her passengers, to render assistance to everybody, even though an enemy, found at sea in danger of being lost
- explains that the convention also applies to assistance or salvage services rendered by or to a ship of war or any other ship owned, operated or chartered by a State or Public Authority
- explains the provision of security by the owner and the application of the salvor's maritime lien

Lloyd's Standard Form of Salvage Agreement (LOF, 1995)

- describes the Contractor's agreed endeavours to salve the ship and/or cargo, bunkers and stores and while performing the salvage services to prevent or minimize damage to the environment
- describes the exception to the 'no cure – no pay' principle
- states that the Contractor's remuneration is to be fixed by arbitration in London and any differences arising out of the Agreement are to be dealt with in the same way
- states that the provisions of the Agreement apply to salvage services, or any part of such services, referred to in the Agreement which have been already rendered by the Contractor at the date of the Agreement

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- states that English Law is the governing law of the Agreement and of arbitration under it
- describes the obligation of the owners, their servants and agents to co-operate with the salvors
- describes the Contractor's duty immediately after the termination of the services to notify the Council of Lloyd's and where practicable the owners of the amount for which he requires security
- explains that the owners of the vessel, their servants and their agents should use their best endeavours to ensure that cargo owners provide their proportion of security before the cargo is released
- explains that, pending the completion of the security, the Contractor has a maritime lien on the property salved for his remuneration
- briefly describes how claims for arbitration are decided
- states that the master or other person signing LOF on behalf of the property to be salved enters into the agreement as agent for the vessel, her cargo, freight, bunkers, stores and any other property thereon and the respective owners thereof and binds each to the due performance thereof
- states that when there is no longer any reasonable prospect of a useful result leading to a salvage reward in accordance with Convention Article 13 the owners of the vessel shall be entitled to terminate the services of the Contractor by giving notice to the Contractor in writing
- describes the provisions for special compensation set out in Convention Article 14

* Convention on Limitation of Liability for Maritime Claims, 1976 (LLMC 1976) (1 hour) — R32

- lists the persons entitled to limit liability
- lists the claims subject to limitation of liability
- lists the claims exempted from limitation
- explains the circumstances in which limitation would be barred
- explains that, except for claims in respect of death or injury of passengers, the calculation of limits of liability is based on the ship's gross tonnage
- explains that the limit for claims in respect of death or injury of passengers is based on the number of passengers the ship is authorized to carry, subject to a maximum sum
- describes the constitution of a limitation fund
- states the scope of application of the Convention

Classification Societies (1 hour)

- explains the reasons for having a ship classed with a classification society
- states that the majority of ships are built under survey
- explains that the classification society approves plans, examines the manufacture of parts and tests materials during the building of hull, machinery, equipment and, where appropriate, refrigerating machinery

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- explains that equipment refers to anchors, chain cables, mooring ropes and wires, mooring arrangements, windlasses and mooring winches

- states that, if requested, the classification societies will also survey and certificate cargo-handling equipment

- states that on satisfactory completion of surveys and sea trials the society issues certificates of class, which are kept aboard ship, and enters the particulars of the ship in its register

- states that a classification society will also survey an existing ship providing it meets the society's rules regarding scantlings, materials, workmanship and condition, assign a class to it

- states that to retain its class a ship must undergo periodical surveys as laid down in the society's rules

- states that periodical surveys are:
  - annual survey
  - docking survey at approximately 2-yearly intervals
  - intermediate survey
  - special survey every 4 years, which may be extended to five years

- explains the special survey requirements may be met by a system of continuous survey such that the interval between successive surveys on any given item does not exceed 5 years

- states that an occasional survey, additional to the regular surveys, must be conducted after any damage to the hull, machinery or equipment which may affect the ship's seaworthiness

- states that repairs or alterations must be carried out under survey and to the satisfaction of the society's surveyors

- states that classification societies carry out surveys for the issue of statutory certification on behalf of many governments

- states that a classification society may be asked to conduct the loading port survey on its classed refrigerating machinery

- explains that, when convenient, the loading port survey may be combined with a periodical survey for classification

* **Cargo** (5 hours) — R35

International Convention for the Unification of Certain Rules of Law Relating to Bills of Loading, as Amended by the Protocol of 1968 (Hague-Visby Rules)

- defines:
  - carrier
  - contract of carriage
  - goods
  - ship
  - carriage of goods

- lists the duties of the carrier to make the ship seaworthy and fit for the carriage of cargo

- describes the carrier's duty to care for the cargo

- describes the duty of the carrier, master or agent of the carrier to issue a bill of lading

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- lists the information which should be shown in a bill of lading
- explains that a bill of lading is prima facie evidence of the receipt by the carrier of the goods as described in it and proof to the contrary is not admissible when the bill of lading has been transferred to a third party acting in good faith
- explains that the shipper is deemed to have guaranteed the accuracy of marks, number, quantity and weight as furnished by him, and that the shipper is to indemnify the carrier against loss arising from inaccuracies in such particulars
- explains the duty of the carrier, master or agent to issue a 'shipped' bill of lading after the goods are loaded, provided the shipper surrenders any previously taken up document of title
- explains the mandatory domain of the Hague-Visby rules
- explains the carrier's liability for loss or damage arising or resulting from unseaworthiness
- states that whenever loss of damage has resulted from unseaworthiness, the burden of proving due diligence is on the carrier
- lists the exceptions to the carrier's responsibility for loss or damage
- explains the shipper's responsibility for loss or damage sustained by the carrier or ship
- states the right to deviate for the purpose of saving life or property
- explains the limitation of liability for loss or damage and the circumstances in which benefit of limitation is lost
- describes the provisions regarding goods of an inflammable, explosive or dangerous nature
- explains the liability of the carrier's servants (Himalaya clause)
- explains that this Convention does not apply to charter-parties, but, if bills of lading are issued under a charter party, they must comply with the terms of this Convention
- states that any lawful provisions regarding general average may be inserted in a bill of lading
- explains that, in certain circumstances, goods may be carried under an agreement between the carrier and shipper in any contractual terms not contrary to public policy, provided that no bill or lading is issued and that the terms agreed are embodies in a non-negotiable receipt, marked as such
- explains that the Rules do not prevent a carrier or shipper entering into any agreement regarding loss of damage to goods prior to the loading on, and subsequent to, the discharge from the ship on which the goods are carried by sea
- states that the Convention does not affect the rights and obligations of the carrier under any statute relating to the limitation of the liability of owners of sea-going ships
- describes the scope of application of the provisions of this Convention
- describes briefly the system of documentary credit in the sale of goods during shipment

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

Charter Parties

- states that a charter-party is a contract between the shipowner and the charterer for the use of a ship or her cargo space
- explains that a voyage charter-party is a contract to carry a specified, normally full, cargo between named ports at an agreed freight rate
- explains that the shipowner remains responsible for the operation of the ship and the costs involved, but the charterer sometimes pays the stevedoring charges
- states that contracts are normally drawn up using standard charter-party forms amended as required by alterations and additional clauses
- describes the tendering of notice of readiness at the loading port
- explains that if the ship is not ready to receive cargo, whether alongside or not, by the cancellation date the charterer may cancel the charter
- explains what is meant by laytime and the terms 'running days/hours', 'Sundays and holidays excepted' and 'weather working days'
- states that the laytime for loading and discharging may be stated separately or as a total
- states that all times relevant to cargo working should be recorded in the log-book and time sheets for the calculations of laytime completed as a check on the charterer's laytime statement
- explains that if cargo work is not completed within the permitted laytime, the charterer is liable to pay demurrage at the agreed rate per day or hour until it is completed
- explains that time lost due to defects of the ship or its equipment is not counted in the laytime
- explains that in the event of cargo work being completed before the expiration of laytime, despatch is usually payable by the shipowner to the charterer
- states that bills of lading are normally issued under a voyage charter-party and signed by the master or on his behalf
- explains that the bills of lading may incorporate the terms of the charter-party which, in any case, takes precedence over the bills of lading as between shipowner and charterer
- explains that when bills of lading have been transferred to a third party they constitute the contract between the shipowner and that party
- states that a voyage charter may be arranged to cover a stated number of successive voyages or an unspecified number of voyages to be performed in a given time
- states that in a time charter-party the charterer agrees to hire the ship for a specified period of time
- explains that the charterer may use the vessel for any voyage he wants within the trading area agreed in the charter-party
- explains that the charterer pays for bunkers and for cargo loading and discharging, port dues, canal dues and pilotage

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- states that owners pay crew costs and for provisions, necessary stores, insurance of the ship and the costs of maintaining the ship in class and keeping it in an efficient condition to carry out the charterer's wishes
- states that the charter-party contains a description of the ship, including its speed and fuel consumption
- explains that inability to maintain the warranted speed or consumption as a result of heavy weather or other cause should be substantiated by entries in the log-book
- states that crew overtime in connection with the cargo is usually for the account of the charterer, and separate time sheets should be kept
- explains that the off-hire clause states the circumstances in which payment of hire ceases during time lost to the charterer
- explains that off-hire deductions may be made for time lost due to reduced-speed resulting from defects of ship or machinery, for the cost of additional fuel and for extra expenses
- states that the master is usually required to sign bills of lading as presented to him by the charterer or the charter-party may give the charterer the right to sign them on his behalf
- states that a time charter-party may be used for a single round voyage
- describes the master's actions regarding damage done by stevedores to the ship or cargo
- explains that <u>demise</u> or <u>bareboat charter-party</u> is a leasing arrangement in which the charterer operates the ship as if it were his own
- states that the master and crew are employed by the charterer, to whom they are responsible as if he were the owner
- explains that a <u>tonnage contract</u> or <u>contract of affreightment</u> may be used where a shipper needs to transport large quantities over a long period
- explains that the contract does not name particular ships and the shipowner is free to use any suitable ship, his own or chartered, for each shipment
- states that the loading dates are specified and that punctual performance is essential
- states that each individual shipment is normally subject to the terms of a conventional voyage charter-party

* **'Hamburg Rules' Maritime Legislation** (1 hour)

- explains the effect of charges where goods are carried under Hamburg Rules
- explains carrier's extended liability for loss or damage to the goods
- explains reductions to exception to liability, inward and outward bills of lading, live animals and deck cargo
- explains the need to inform P & I Club where goods are carried under Hamburg Rules

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

General Average and Marine Insurance (3 hours)

The York-Antwerp Rules, 1974

- states that where the York-Antwerp Rules apply, general average should be adjusted according to the Rules to the exclusion of any law or practice inconsistent with them
- defines a general average act
- states that general average sacrifices and expenses are to be borne by the different contributing interests on the basis of these Rules
- explains that only such losses, damages or expenses which are the direct consequence of the general average act are allowed as general average and that no indirect loss whatsoever will be admitted
- explains that rights to contribution in general average when the event which gave rise to the sacrifice was due to the fault of one of the parties to the adventure
- states that the onus of proof is upon the party claiming in general average to show that the loss or expense claimed is properly allowable as general average
- states that any extra expense incurred in place of another expense which would have been allowable as general average is deemed to be general average, but only up to the amount of the general average expense avoided
- explains that general average is to be adjusted, as regards both loss and contribution, on the basis of values at the time and place when and where the adventure ends
- states that the general principles contained in Rules A to G are amplified by numbered rules I to XXII, dealing with specific points of practice
- states that the master should make a declaration of general average, as is required by the law and custom of the port, at a port of refuge and at a discharging port when general average damage to the cargo is suspected
- explains the duty of the master to see to it that general average contributions (average bonds) are collected for the benefit of those entitled to them, whether they are cargo owners or shipowners, exercising the shipowner's lien on the cargo, where necessary, until they are paid

Marine Insurance

- explains in general terms the purpose of marine insurance
- explains what is meant by an insurable interest
- describes briefly how insurance is arranged through brokers
- explains the principle of 'utmost good faith'
- explains the effect of misrepresentation or non-disclosure of material circumstances known to the assured
- explains 'warranty' and the effect on a marine insurance policy of breach of warranty
- describes briefly voyage policies, time policies and floating policies
- explains what is meant by deviation and how the insurer is discharged from liability from the moment a ship deviates

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- lists permitted deviations
- explains that a deviation clause will often permit the assured to extend his cover at a premium to be arranged, provided the insurer is given prompt notice of the deviation ('held covered' clause)
- describes briefly the perils usually covered in a marine insurance policy
- explains the use of 'Institute Clauses'
- explains the 'duty of assured' clause ('Sue and Labour' clause)
- distinguishes between partial loss, total loss and constructive total loss
- explains what is meant by 'particular average'
- explains the doctrine of subrogation
- explains the function of Protection and Indemnity Associations (P and I clubs)
- lists risks, liabilities and expenses covered by P and I clubs

1.7 Methods and Aids to Prevent Pollution of the Marine Environment by Ships (2 hours)

Convention of the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention) (LDC) R21

- explains the aims of the Convention
- defines, for the purpose of the Convention:
  - dumping
  - wastes or other matter
  - special permit
  - general permit
- states that the dumping of wastes or other matter in whatever form or condition, as listed in annex I, is prohibited
- states that the dumping of wastes or other matter listed in annex II requires a prior special permit
- states that the dumping of all other wastes or matter requires a prior general permit
- explains that the provisions of Article IV do not apply when it is necessary to secure the safety of human life or of vessels in cases of 'force majeure' caused by stress of weather, or in any case which constitutes a danger to human life or a real threat to vessels
- states that such dumping should be done so as to minimize the likelihood of damage to human or marine life and must be reported immediately
- states that the Addendum to Annex I contains regulations on the incineration of wastes at sea
- explains that the appropriate authority of a Contracting Party should issue prior special or general permits in respect of matter intended for dumping:
  - loaded in its territory
  - loaded by a vessel flying its flag when the loading occurs in the territory of a State not party to the Convention

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969 R22

- describes the rights of Parties to the Convention to intervene on the high seas following a maritime casualty
- defines, for the purposes of the Convention:
  - maritime casualty
  - ship
  - oil
  - related interests
- describes the provisions which a coastal State should apply when exercising the right to take measures in accordance with Article I

Protocol relating to Intervention on the High Seas in Cases of Pollution by Substances other than Oil, 1973

- describes the rights of Parties to the Protocol to intervene on the high seas following a maritime casualty
- defines 'substances other than oil'
- explains that the Protocol extends the rights and obligations of coastal States to cases involving imminent threat of pollution by substances other than oil

International Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC 1969) R23

- states that no claim for compensation may be made against the servants or agents of the owner
- explains that, with certain exceptions, the owner may limit his liability by constituting a fund for the sum representing the limit of his liability with the Court of a Contracting States where the action is brought
- states that claims in respect of expenses reasonably incurred by the owner voluntarily to prevent or minimize pollution damage rank equally with other claims against the fund
- explains that where a fund has been constituted and the owner is entitled to limit his liability, no person having a claim for pollution damage resulting from that incident is entitled to exercise any rights over other assets of the owner and that the ship or any other property belonging to the owner should be released
- states that the owner of a ship registered in a Contracting State and carrying more than 2,000 tons of oil in bulk as cargo is required to maintain insurance in the sum of his limit of liability
- states that the appropriate authority of a Contracting State, after determining that the requirements have been, complied with, should issue a certificate attesting that insurance or other financial security is in force
- states that the certificate should be carried on board ship and a copy deposited with the relevant authorities
- states that a Contracting State must not permit a ship under its flag to which this Article applies to trade without a certificate

COMPETENCE 3.2	Monitor and Control Compliance with Legislative Requirements	IMO Reference

- states that Contracting States must ensure under their national legislation, that insurance or other security is in force in respect of any ship, whenever registered, entering or leaving their ports of offshore terminals if the ship actually carries more than 2,000 tons of oil in bulk as cargo

1.8 National legislation for implementing international agreements and conventions

- see Instructor Guidance Notes

COMPETENCE 3.3	Maintain Safety and Security of Crew and Passengers and the Operational Condition of Safety Equipment	IMO Reference

TRAINING OUTCOMES:

STCW Code
Table A-II/2

Demonstrates a knowledge and understanding of:

3.3.1 LIFE-SAVING APPLIANCE REGULATIONS (SOLAS)

3.3.2 ORGANIZATION OF FIRE AND ABANDON SHIP DRILLS

3.3.3 MAINTENANCE OF LIFE-SAVING, FIRE-FIGHTING AND OTHER SAFETY SYSTEMS

3.3.4 ACTIONS TO PROTECT AND SAFEGUARD ALL PERSONS ON BOARD IN EMERGENCIES

3.3.5 ACTIONS TO LIMIT DAMAGE AND SAVE THE SHIP FOLLOWING A FIRE, EXPLOSION, COLLISION OR GROUNDING

COMPETENCE 3.3	Maintain Safety and Security of Crew and Passengers and the Operational Condition of Safety Equipment	IMO Reference

3.3.1 LIFE-SAVING APPLIANCE REGULATIONS (SOLAS)

Textbooks:
Teaching aids: A1

Required performance:

1.1 Life-Saving Appliance Regulations (SOLAS) (2 hours) R2

- demonstrate a knowledge of the regulations concerning life-saving appliances and arrangements (SOLAS), including the LSA Code

3.3.2 ORGANIZATION OF FIRE AND ABANDON SHIP DRILLS

Required performance:

2.1 Organization of Fire and Abandon Ship Drills

- See IMO Model Courses 1.23 and 2.03

3.3.3 MAINTENANCE OF LIFE-SAVING, FIRE-FIGHTING AND OTHER SAFETY SYSTEMS

Required performance:

3.1 Maintenance of Life-saving, Fire-fighting and Other Safety Systems

- See IMO Model Courses 1.23 and 2.03

COMPETENCE 3.3	Maintain the Safety and Security of Crew and Passengers and the Operational Condition of Safety Equipment	IMO Reference

3.3.4 ACTIONS TO PROTECT AND SAFEGUARD ALL PERSONS ON BOARD IN EMERGENCIES

Textbooks: T10
Teaching aids: A1, V9

Required performance:

4.1 Actions to Protect and Safeguard all Persons on Board in Emergencies (4 hours) — R1, R2

- states that some crew members will be assigned specific duties for mustering and control of passengers
- lists those duties as:
  - warning the passengers
  - ensuring that all passenger spaces are evacuated
  - guiding passengers to muster stations
  - maintaining discipline in passageways, stairs and doorways
  - checking that passengers are suitably clothed and that lifejackets are correctly donned
  - taking a roll-call of passengers
  - instructing passengers on procedure for boarding survival craft or jumping into the sea
  - directing passengers to embarkation stations
  - instructing passengers during drills
  - ensuring that a supply of blankets is taken to the survival craft

Rescue of Persons from a Vessel in Distress or from a Wreck — R1

- states why it is preferable to wait for daylight when no immediate danger exists
- states that communications should be established between the ships and the method of rescue agreed upon when time permits
- states that rescue boats or motor-lifeboats would be used if conditions permitted
- states that unnecessary equipment should be removed from the boats and replaced by lifejackets, lifebuoys, blankets and a portable VHF radio
- states that the rescue vessel should reconnoitre the area to see if there is any wreckage which could be a danger to boats
- describes how both ships can spread oil in rough weather
- describes the preparations for taking survivors on board from the boats
- describes how to provide a lee and launch boats
- describes how boats should approach the wreck and pick up survivors
- describes the recovery of boats and survivors
- describes the methods of rescue which may be used when sea conditions are too dangerous to use boats

COMPETENCE 3.3	Maintain Safety and Security of Crew and Passengers and the Operational Condition of Safety Equipment	IMO Reference

Man-overboard Procedure R1

- describes methods of recovering a person from the sea when heavy weather prevents the use of the normal manoeuvres and boats
- describes and explains the actions to take when a person is reported missing at sea

3.3.5 ACTIONS TO LIMIT DAMAGE AND SAVE THE SHIP FOLLOWING A FIRE, EXPLOSION, COLLISION OR GROUNDING

Textbooks: T10
Teaching aids: A1

Required performance:

5.1 Actions to Limit Damage and Save the Ship following a Fire, Explosion, Collision or Grounding (4 hours) R1

Means of limiting damage and salving the ship following a fire or explosion

- describes methods of fighting fires (see IMO Model Course 2.03, Advanced Training in Fire Fighting)
- states that cooling of compartment boundaries where fire has occurred should be continued until ambient temperature is approached
- explains the dangers of accumulated water from fire fighting and describes how to deal with it
- states that watch for re-ignition should be maintained until the area is cold
- describes the precautions to take before entry to a compartment where a fire has been extinguished
- describes the inspection for damage
- describes measures which may be taken to plug holes, shore-up damaged or stressed structure, blank broken piping, make safe damaged electrical cables and limit ingress of water through a damaged deck or superstructure
- outlines the measures to be taken when the inert-gas main and gas lines to a mast riser are fractured
- states that continuous watch should be kept on the damaged area and temporary repairs
- states that course and speed should be adjusted to minimise stresses and the shipping of water

Procedure for Abandoning Ship

- states that a ship should only be abandoned when imminent danger of sinking, breaking up, fire or explosion exists or other circumstances make remaining on board impossible

COMPETENCE 3.3	Maintain the Safety and Security of Crew and Passengers and the Operational Condition of Safety Equipment	IMO Reference

- states that a distress call should be transmitted by all available means until acknowledged
- lists the information to include in the distress message
- describes other distress signals which may be used to attract attention
- describes the launching of boats and liferafts when the ship is listing heavily
- describes the launching of boats and liferafts in heavy weather conditions
- describes the use of oil to calm the sea surface and explains why fuel oil is not suitable

COMPETENCE 3.4	Develop Emergency and Damage Control Plans	IMO Reference

TRAINING OUTCOMES:

STCW Code
Table A-II/2

Demonstrates a knowledge and understanding of:

3.4.1 THE PREPARATION OF CONTINGENCY PLANS FOR RESPONSE TO EMERGENCIES

3.4.2 SHIP CONSTRUCTION, INCLUDING DAMAGE CONTROL

3.4.3 METHODS AND AIDS FOR FIRE PREVENTION, DETECTION AND EXTINCTION

3.4.4 FUNCTIONS AND USE OF LIFE-SAVING APPLIANCES

COMPETENCE 3.4	Develop Emergency and Damage Control Plans	IMO Reference

3.4.1 THE PREPARATION OF CONTINGENCY PLANS FOR RESPONSE TO EMERGENCIES

Textbooks: T10
Teaching aids: A1, V10, V11

Required performance:

1.1 Contingency Plans for Response to Emergencies (9 hours) R1, R2

- draws up a muster list and emergency instructions for a given crew and type of ship
- assigns duties for the operation of remote controls such as:
  - main engine stop
  - ventilation stops
  - lubricating and fuel oil transfer pump stops
  - dump valves
  - CO_2 discharge
  - watertight doors

  and for the operation of essential services such as:
  - emergency generator and switchboard
  - emergency fire and bilge pumps
- describes the division of the crew into a command team, an emergency team, a back-up emergency team and an engine-room emergency team
- explains the composition of the emergency teams in the above objective
- states that crew members not assigned to emergency teams would prepare survival craft, render first aid, assemble passengers and generally assist the emergency parties as directed
- designates muster positions for the command team, both at sea and in port
- designates muster positions for the emergency teams
- states that the engine-room emergency team would take control of engine-room emergencies and keep the command team informed
- states that good communications between the command team and the emergency teams are essential
- draws up plans to deal with:
  - fire in specific areas, such as galley, accommodation, engine-room or cargo space, including co-ordination with shore facilities in port, taking account of the ship's fire-control plan
  - rescue of victims of a gassing accident in an enclosed space
  - heavy-weather damage, with particular reference to hatches, ventilators and the security of deck cargo
  - rescue of survivors from another ship or from the sea
  - leakages and spills of dangerous cargo
  - stranding
  - abandoning ship
- explains how drills and practices should be organized
- describes the role of a shipboard safety committee in contingency planning

COMPETENCE 3.4	Develop Emergency and Damage Control Plans	IMO Reference

Actions to be Taken when Emergencies Arise in Port — R1, R2

- describes actions to take in the event of fire on own ship, with particular reference to co-operation with shore facilities
- describes action which should be taken when fire occurs on a nearby ship or an adjacent port facility
- describes the circumstances in which a ship should put to sea for reasons of safety
- describes the actions which can be taken to avoid a ship dragging anchor towards own ship in an anchorage
- describes the actions and precautions to take when a submarine cable is lifted by the anchor
- describes how to buoy and slip an anchor
- describes how an anchor may be recovered when no power is available at the windlass

3.4.2 SHIP CONSTRUCTION, INCLUDING DAMAGE CONTROL — R1, R2

Textbooks:
Teaching aids: A1

Required performance:

2.1 Flooding of Compartments (4 hours)

- defines:
  - margin line
  - permeability of a space
- explains what is meant by 'floodable length'
- explains what is meant by 'permissible length of compartments' in passenger ships
- describes briefly the significance of the factor of subdivision
- states the assumed extent of damage used in assessing the stability of passenger ships in damaged condition
- summarizes, with reference to the factor of subdivision, the extent of damage which a passenger ship should withstand
- describes the provisions for dealing with asymmetrical flooding
- states the final conditions of the ship after assumed damage and, where applicable, equalization of flooding
- states that the master is supplied with data necessary to maintain sufficient intact stability to withstand the critical damage
- explains the possible effects of sustaining damage when in a less favourable condition
- distinguishes between ships of Type 'A' and Type 'B' for the purposes of computation of freeboard — R5

COMPETENCE 3.4	Develop Emergency and Damage Control Plans	IMO Reference

- describes the extent of damage which a Type 'A' ship of over 150 metres length should withstand
- explains that a Type 'A' ship of over 150 metres length is described as a 'one-compartment' ship
- describes the requirements for survivability of Type 'B' ships with reduced freeboard assigned
- summarizes the equilibrium conditions regarded as satisfactory after flooding
- states that damage to compartments may cause a ship to sink as a result of:
  - insufficient reserve buoyancy, leading to progressive flooding
  - progressive flooding due to excessive list or trim
  - capsizing due to loss of stability
  - structural failure

3.4.3 METHODS AND AIDS FOR FIRE PREVENTION, DETECTION AND EXTINCTION

STCW Code Table A-II/2

Textbooks:
Teaching aids:

Required performance:

3.1 Methods and Aids for Fire-prevention, Detection and Extinction

- See IMO Model Course 2.03

3.4.4 FUNCTIONS AND USE OF LIFE-SAVING APPLIANCES

Textbooks:
Teaching aids:

Required performance:

4.1 Functions and Use of Life-saving Appliances

- See IMO Model Course 1.23

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

TRAINING OUTCOMES:

Demonstrates a knowledge and understanding of: — STCW Code Table A-II/2

3.5.1 PERSONNEL MANAGEMENT, ORGANISATION AND TRAINING ON BOARD SHIP

3.5.2 RELATED INTERNATIONAL CONVENTIONS AND RECOMMENDATIONS, AND NATIONAL LEGISLATION

COMPETENCE 3.5 Organize and Manage the Crew **IMO Reference**

3.5.1 PERSONNEL MANAGEMENT, ORGANIZATION AND TRAINING ON BOARD SHIP

Textbooks: T72
Teaching aids: A1, V12, V13, V14

Required performance:

1.1 Personnel Management (10 hours)

Principles of Controlling Subordinates and Maintaining Good Relationships R1

- states that the principles include:
  - being consistently calm and even in temperament when giving orders and dealing with offenders
  - being honest and fair in all matters, and being firm when necessary
  - treating all staff on the same basis, i.e. having no favourites
  - avoiding causing disappointment to staff
  - avoiding making promises, if possible; if any are made, then they <u>must</u> be kept. The number of promises made should be restricted to perhaps three, as they can be remembered easily
  - keeping staff well informed
  - choosing the more difficult path of making, rather than breaking, a person who has been an offender
  - having a proper attitude towards spokesmen or representatives of trade unions
  - making allowances for differences in nationality, language, religion and other cultural matters affecting behaviour and attitude

-
  - making changes to a management method to allow for the personality of the user
  - being in control as a necessity for good management
  - being aware that managing staff on a ship in a declining fleet is more difficult than normal
  - being aware of the factors which govern attitudes of staff
  - ensuring that all staff feel that their services on board are appreciated
  - having a good attitude to staff welfare by:
    - being helpful when a member of staff requires assistance on a personal problem
    - encouraging the social life of the ship
    - keeping a watchful eye on the on-board consumption of alcohol, the use of cannabis resin (hash) and hard drugs such as cocaine and its derivatives and illegal trading in pornographic material, and when necessary applying early correction

Staff Attitudes

- states that the reasons why people work include the following:
  - the need to earn money
  - the need to be a useful member of society
  - the need for security of their standard of living

-
  - the need to use their manual and mental skills and to derive satisfaction from them
  - the need to achieve their ambitions and improve their status
  - the desire to have authority over other people, even for an indirect reason such as avoiding being controlled by a bully

COMPETENCE 3.5 Organize and Manage the Crew **IMO Reference**

Exercise of Authority

- explains why a person must make his own authority, and states that:
  - the appointment of a person to a higher rank gives potential authority only
  - the real authority of a rank is achieved when the person concerned demonstrates that he is fit for the rank by showing that:
    - he knows the work
    - he is decisive
    - his decisions are generally correct
    - his orders are clear and are quickly carried out without argument
    - he seeks advice when necessary and helps others
    - he can accept orders from superiors and carry them out
    - the need for a person to be accepted by those with whom he works

Group Behaviour

- states that group behaviour, discipline and the amount of work done by the crew are affected by:
  - the need for a person to be accepted by those with whom he works
  - the identification of the main groups on a ship, e.g. deck department officers and crew, and similarly, for other departments, depending on how the ship is manned
  - unofficial groupings, for example by nationality or religion
  - keeping the aims of the groups in line with the well-being of the ship, its commercial success and with the aims of the owning company
  - conflict between a self-chosen leader of a group and the appointed leader

- describes how the performance of individuals can be affected by conforming to the behavioural patterns of the group

Conditions of Employment

- lists methods for obtaining officers and crew as:
  - direct employment by a shipping company
  - employment through a national organization
  - employment through a trade union
  - employment through an agency
  - employment through a combination of any of these methods and discusses how attitudes to work vary with the method of recruitment

- states that conditions of service can vary between countries and between companies, but may include:
  - salary scales for officers and crew
  - a career structure for officers and crew
  - salary scales which show 'begin at' rates, with increments for seniority and qualifications
  - leave scales, showing how the leave is earned and paid
  - other allowances, showing items such as subsistence allowances, where applicable, and paid study leave when studying for Certificates of Competency issued by an Administration
  - other benefits, such as insurance and pension arrangements, whether contributory or not, or whether included in salary payment
  - other information, such as whether overtime is paid separately and at what rates

- states that, for safety and operational reasons, the officers and crew must be able to communicate with each other in a common language and those responsible for the mustering and safety of passengers must be able to communicate effectively with them

- states that officers and crew should have had the necessary training appropriate to their duties

- states that officers and crew must be informed as to the scope and methods used for training aboard the ship

COMPETENCE 3.5 Organize and Manage the Crew **IMO Reference**

1.2 Organization of Staff (9 hours)

Manning Arrangements

– states that the organization on board depends on ship design and manning arrangements, including:
  - whether or not the ship has unattended machinery space (UMS) and bridge control of main engines
  - how the hatch covers are operated and how labour-intensive this is
  - whether or not an automatic pilot is fitted
  - how labour-intensive is the operation of cargo valves on a tanker
  - how labour-intensive is tank cleaning on a tanker
  - whether special paints have been used, to reduce the need for painting by the crew
  - to what extent hydraulic spanners are used for speedy removal and replacement of nuts, especially in the engine-room
  - which manning arrangement is adopted:
    - conventional departmental system
    - general-purpose (GP) crew
    - inter-departmental flexibility (IDF)
  - which systems are acceptable to an Administration

Analysis of Work

– states that the following should be included:
  - statutory and non-statutory requirements
  - watchkeeping
  - maintenance
  - cargo work
  - testing systems
  - training for emergencies
  - training for the education and training of others on board
  - associated work, in particular:
    - mooring and unmooring
    - food and hygiene
    - storing and bunkering
    - preparing for dry-docking and surveys
    - administration
    - evaluation of personnel
    - hours of work

Allocation of Staff

– states that the master is responsible for the allocation of all staff duties, but that the following arrangements are typical:
  - a conventional departmental system in which:
    - the chief engineer officer is responsible for all work associated with machinery, including deck machinery
    - the chief officer, in addition to watchkeeping, is responsible for all work associated with deck equipment and cargo handling
    - the purser/catering officer is responsible for all work associated with obtaining, storing and processing food
    - each of the above is responsible for all work associated with training and the prevention of unhygienic conditions and accidents in their respective fields
  - a general-purpose crew:
    - as per company practice

Organizing for Safety and Emergencies

– states that, at least, the following actions are required:
  - appointment of a safety officer, who may be chosen from the list of officers
  - appointment of a fire officer, who would normally be the chief officer
  - appointment of the chief engineer as technical adviser to the fire officer for fires in machinery spaces

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

– preparation and display of the muster list and the distribution of muster cards to all staff
– checking that all fire-fighting and emergency equipment, including survival craft, is serviceable
– holding fire and abandon ship drills as soon as is practicable after the crew joins the ship, in accordance with SOLAS requirements

Organizing for Staff Duties

R2

A-VIII/1

– draws up watchkeeping, security and other rotas for use while at sea and in port, with regard to fitness for duty including those:
- for deck:
  - watchkeeping officers and their duties
  - helmsmen's duties
  - gangway duties

– – for radioroom and GMDSS
- for engine-room:
  - watchkeeping officers on their duties
  - in UMS condition, officers in charge
  - day-work officers and staff, with their duties
- for catering staff:
  - galley duties
  - saloon duties
  - accommodation duties

Organizing for Maintenance

– lists, where appropriate to the skill of the trainee, the checklists and work schedules, including:
- safety:
  - fire and boat stations alarms and fire detectors
  - maintaining survival craft and equipment
  - maintaining all fixed and portable fire-extinguishing equipment, including fireman's outfits
  - emergency generation and emergency fire pump
  - deck:
    - painting schedules
    - deck machinery
    - windlasses
    - cargo winches and cranes
    - self-tensioning mooring winches, ropes and wires
    - instruments, including logs and echo sounders
  - radioroom:
    - radio and radar equipment
  - engine-room:
    - planned maintenance schedules of machinery
    - steering gear
    - electrical equipment and wiring systems
    - control systems and automation equipment
    - deck machinery
    - domestic services, including hot and cold water, sanitary services, air conditioning, domestic cold rooms and galley refrigerators
  - catering:
    - accommodation
    - galley
    - refrigerated and dry storerooms

Ship's Records

– lists the records and certificates which have to be kept on board and maintained in good order, including:
- document of nationality (ship's register)
- official log-book
- drawings and diagrams supplied by the shipyard
- instruction books supplied by the shipyard

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

- company's instructions and circulars
- test certificates for wires, shackles and lifting gear
- Administration and classification society certificates as appropriate to the type of ship and including:
  - Passenger Ship Safety Certificate
  - Cargo Ship Safety Construction Certificate
  - Cargo Ship Safety Equipment Certificate
  - Cargo Ship Safety Radiotelegraphy Certificate
  - Exemption Certificate
  - Load Line Certificate
  - Classification – hull and machinery survey certificates
  - Classification – records of surveys for continuous survey system for an oil tanker, Certificate of third party insurance for oil spills — R2
  - ship's Oil Record Book
  - Safety Management Certificate (SMC) (ISM)
  - certified copy of Document of Compliance (DOC) (ISM)
  - Safe Manning Document

Organizing Communication on the Ship

- states that the holding of regular meetings is a good method of keeping staff informed and providing liaison on matters relating to:
  - the general operation of the ship)
  - safety)
  - maintenance)

  With special Reference to Safety Management System (SMS)

- states that, preferably, safety meetings should be held monthly and management meetings weekly

- states that the chairman and composition of committees should be agreed with the master except where stipulated by national rules, e.g. election of representatives to the safety committee

- states that the basics on which the meetings are run should include:
  - producing an agenda which will limit the scope of a meeting
  - the keeping of minutes and their confirmation by the committee concerned
  - restricting the duration of a meeting to about one hour

- states that the minutes of meetings should be sent to those persons who attended the meeting and, after confirmation, to others as required by the master

Meeting Techniques

- describes the influence of training on meeting technique and on how a person must conduct himself

- describes:
  - the ideal size of a group
  - the duration of a group meeting

- states the situations when:
  - meetings are convenient
  - other methods of communication can be used

- describes the types of meeting

- prepares a meeting agenda and timetable

- makes preparation for and conducts a meeting

- deals successfully with disagreements

- explains the steps taken to follow-up conclusion of a meeting

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

- describes the most common pitfalls concerning:
  - the subjects
  - the arrangement
  - the disregarding of meeting techniques

- defines, for the requirements of on-board ship administration:
  - the types of meeting that are necessary
  - the objectives of the meetings
  - the preferred sequence of the meetings

1.3 Training on Board Ships (12 hours) — R2

Training Methods

- explains the purpose of on-board training

- describes the preparation needed before the start of a training session

- states why training should be relevant to the trainees' work and duties aboard ship

- demonstrates how to conduct a training session for a given topic

- describes how to maintain interest in routine training such as fire drills and abandon ship drills

- describes methods for training
  - in attitude
  - in skills
  - in knowledge

- lists the areas in which training is required and areas in which it is desirable

- delivers a training session to other members of the class

- states that training in the use of life-saving appliances and on the best method of survival should be based on the training manual on the ship and should include the following:
  - donning of lifejackets and immersion suits, as appropriate
  - muster at the assigned stations
  - boarding, launching and clearing the survival craft and the rescue boats
  - method of launching from within the survival craft
  - release from launching appliances
  - methods and use of devices for protection in launching areas, where appropriate
  - illumination in launching areas
  - use of all survival equipment
  - use of all detection equipment
  - with the assistance of illustrations, the use of radio life-saving appliances
  - use of drogues
  - use of engine and accessories
  - recovery of survival craft and rescue boats, including their stowage and securing
  - hazards of exposure and the need for warm clothing
  - best use of survival craft facilities in order to survive

- – methods of retrieval, including the use of helicopter rescue gear (slings, baskets, stretchers), breeches buoy, and shore life-saving apparatus and ship's line-throwing apparatus
  - all other functions contained in the muster list and emergency instructions
  - instructions for emergency repair of the life-saving appliances

- states that abandon ship drills must be carried out monthly on cargo ships and weekly on passenger ships

COMPETENCE 3.5 Organize and Manage the Crew **IMO Reference**

- states that each member of the crew must be given instructions, which must include:
  - operations and use of the ships's inflatable liferafts
  - problems of hypothermia, first-aid treatment of hypothermia and other appropriate first-aid procedures
  - special instructions necessary for use of the ship's life-saving appliances in severe weather and severe sea conditions

- states that:
  - instructions in the use of the ship's life-saving appliances and in survival at sea should be given at the same interval as the drills
  - individual instructions may cover different parts of the ship's life saving system

- – all of the ship's life-saving equipment and appliances must be covered within any period of 2 months

Emergency Drills

- states that drills should be carried out as follows;
  - routine exercises
  - essential tasks should be repeated at each drill, including:
    - operation of emergency bilge pump
    - operation of remote shut-off valves and remote stop switches
    - checking for ingress of air when handles of fire flaps are in 'closed' position

- lists essential tasks as:
  - donning compressed-air breathing apparatus (CABA)
  - preparing hoses and nozzles
  - collecting foam compound
  - collecting fire extinguishers
  - collecting first-aid gear
  - collecting evacuation equipment

- states that emergency teams are assembled in accordance with the muster list

- states that it may be necessary to improvise when persons are absent from emergency teams

- describes examples of fire drills as:
  - sending teams into cabins, lockers, access hatches and machinery spaces
  - attacking fires with appropriate equipment in cabin, lockers, hatches, galley and machinery spaces
  - evacuating a wounded or unconscious person from the above spaces
  - starting the emergency generator
  - starting the emergency bilge pump

- describes examples of boat drills as:
  - collecting additional survival gear
  - using different disciplines to prepare for launching and to launch survival craft

- states that departmental training may include:

  in the deck department:
  - steering the ship and function of the automatic pilot
  - operation of windlass and mooring winches
  - operation of cargo winches, cranes or derricks
  - securing of cargo or containers
  - operation of bridge control of the main engines
  - operation of the speed log, depth sounder, and gyro-compass and their repeaters
  - operation of the navigation lights and other ship's lights and signals
  - operation of the ship's whistle or siren
  - the recording and care of spares and stores

  in the engine department:
  - operation of the main engine and auxiliaries

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

– operation of electrical alternators and other electrical equipment
– operation of boilers
– operation of steering gear
– operation of oily-water separators
– operation of control and automation equipment
– tracing of pipe lines for the various services such as lubricating oil, fuel oil and fresh and salt water

– – the compiling of methodical inspections
– the recording and care of spare gear and stores

in the catering department:
– operation of galley equipment
– the recording and care of provisions and other materials
– the loading of provisions and dry stores

– states that departmental training may include:

in the deck department:
– maintenance of cargo covers and hatch equipment
– painting hull, deck and superstructure
– planned maintenance procedures
– maintenance of cargo-securing equipment
– gyro-compass and repeaters
– fire extinguishers and fireman's outfits
– survival craft and launching equipment

in the radio department:
– radar scanners and communications aerials
– radars and communication equipment
– emergency radio equipment for survival craft

in the engine department:
– planned maintenance of machinery
– preservation and painting of structures and pipe work
– maintenance of fixed fire-extinguishing systems
– methods and details of servicing and repairing selected items of equipment, e.g. changing piston rings and repairing pumps, alternator engines and fuel injectors
– methods and details of testing and repairing electrical and electronic equipment
– making proper use of drawings and of instruction and maintenance manuals

in the catering department:
– painting of galley, storerooms (not refrigerated) and alleyways, where required
– keeping galley stove and other equipment in good clean condition
– keeping filters and trunks of the galley air extractor fans clean and free of any build-up of grease, to avoid fires

COMPETENCE 3.5	Organize and Manage the Crew	IMO Reference

3.5.2 RELATED INTERNATIONAL CONVENTIONS AND RECOMMENDATIONS, AND NATIONAL LEGISLATION

STCW Code Table A-II/2

Textbooks:
Teaching aids: A1, V14, V15

Required performance:

2.1 Related International Maritime Conventions and National Legislation (2 hours)

R1

The ISM Code

- explains the principles underlying the ISM Code
- describes the content and application of the ISM Code

STCW Convention

- explains the principles underlying the STCW Convention
- describes the content and application of the STCW Convention
- explains the principle of Port State Control with particular reference to:
  –operation of above
  –terms of reference
  –master's responsibility
  –legal standpoint
- explains how to implement the regulations for controlling and monitoring to minimum hours of rest for watchkeepers
- states that after 1 February 2002 all seafarers' watchkeeping certificates will be required to be endorsed by the flag state
- states that seafarers new to a particular type of vessel require ship specific shipboard familiarization
- describes what shipboard familiarization may involve for watchkeeping officers — Reg. I/14
- describes what tasks or duties elementary basic safety familiarization involves for a watchkeeping officer
- describes how to organize shipboard training and how to maintain records
- states that penalties are prescribed for breaches of STCW 95 requirements and that these are determined by the flag state
- states that national legislation is required to implement the provisions of an international convention
- states that for STCW 1995 national legislation is subject to scrutiny and checking by IMO appointed persons
- states national legislation may differ from one flag to another

COMPETENCE 3.6	Organize and Manage the Provision of Medical Care on Board	IMO Reference

TRAINING OUTCOME:

STCW Code
Table A-II/2

Demonstrates a knowledge and understanding of:

3.6.1 THE USE AND CONTENT OF THE FOLLOWING PUBLICATIONS:
– INTERNATIONAL MEDICAL GUIDE FOR SHIPS
– MEDICAL SECTION OF INTERNATIONAL CODE OF SIGNALS
– MEDICAL FIRST AID GUIDE FOR USE IN ACCIDENTS INVOLVING DANGEROUS GOODS

COMPETENCE 3.6	Organize and Manage the Provision of Medical Care on Board	IMO Reference

3.6.1 THE USE AND CONTENT OF THE FOLLOWING PUBLICATIONS:
– INTERNATIONAL MEDICAL GUIDE FOR SHIPS
– MEDICAL SECTION OF INTERNATIONAL CODE OF SIGNALS
– MEDICAL FIRST AID GUIDE FOR USE IN ACCIDENTS INVOLVING DANGEROUS GOODS

Textbooks: T30, T54, T67
Teaching aids: A1, A2, V16

Required performance:

1.1 International Medical Guide for Ships (0.5 hour)

- describes the content and application of the above publication
- extracts and applies information for given situations

1.2 International Code of Signals (Medical Section) (0.5 hour) R55

- describes the content and application of the above publication
- constructs and interprets messages

1.3 Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (3 hours)

- describes the content and application of the above publication
- extracts and applies information for given situations

Appendix 1

INTERNATIONAL LABOUR ORGANISATION

REGISTER OF LIFTING APPLIANCES

and

ITEMS OF LOOSE GEAR

Model Form and Certificates as required by Article 25(2) of the ILO Convention concerning Occupational Safety and Health in Dock Work (No. 152), 1979

INTERNATIONAL LABOUR OFFICE, Geneva
November 1985

Preface

Article 25(2) of the Occupational Safety and Health (Dock Work) Convention, 1979 (No. 152), requires that "a register of the lifting appliances and items of loose gear shall be kept in a form prescribed by the competent authority, account being taken of the model recommended by the International Labour Office".

At its 231st Session (November 1985) the Governing Body of the International Labour Office took note of the information supplied by the Office about the preparation of the model referred to above and authorised the Director-General to inform member States that the Model Form of Register and Certificates required by Article 25(2) of Convention No. 152 are now available.

The new Model Form of Register and Certificates can be used by the competent authority of a member State in prescribing the form provided for in Article 25(2). They replace those drawn up in application of the Protection against Accidents (Dockers) Convention (Revised), 1932 (No. 32), which were standardised and issued by the ILO in 1956.

As in the case of the earlier model documents, they have been prepared in English only. It has been the general practice for the competent national authorities to issue their own Register taking account of the model recommended by the ILO and using the English text of the letter side by side with a translation into their own language.

Form No. 1

Identity of National Authority or Competent Organisation

REGISTER OF SHIPS' LIFTING APPLIANCES AND CARGO HANDLING GEAR

Name of Ship

Official Number

Call Sign

Port of Registry

Name of Owner

Register Number

Date of Issue

Issued by

Signature and Stamp

Note: This Register is the standard international form as recommended by the International Labour Office in accordance with ILO Convention No. 152.

1.

General

The tests, examinations and inspections indicated in this Register are based on the requirements of ILO Convention No. 152 and Recommendation No. 160. They are intended to ensure that ships' lifting appliances are initially certified by a competent person and to establish periodically that they continue to be in safe working order to the satisfaction of a competent person acceptable to the competent authority.

A Register of Lifting appliances and items of loose gear shall be kept in a form prescribed by the competent authority, account being taken of this model recommended by the International Labour Office. This Register and related Certificates shall be kept and be available to any person authorised by the competent authority. The Register and Certificates for gear currently aboard the ship shall be preserved for at least five years after the date of the last entry.

Instructions

1. Initial examination and certification

1.1 Every lifting appliance shall be certified by a competent person before being taken into use for the first time to ensure that it is of good design and construction and of adequate strength for the purpose for which it is intended.

1.2 Before being taken into use for the first time a competent person shall supervise and witness testing, and shall thoroughly examine every lifting appliance.

1.3 Every item of loose gear shall, before being taken into use for the first time be tested, thoroughly examined and certified by a competent person in accordance with national law or regulations.

1.4 Upon satisfactory completion of the procedures indicated above the competent person shall complete and issue the Register of Lifting Appliances and attach the appropriate Certificates. An entry shall be made in Part I of the Register.

1.5 A rigging plan showing the arrangement of lifting appliances shall be provided. In the case of derricks and derrick cranes the rigging plan should show at least the following information:

(a) the position of guys;

(b) the resultant force on blocks, guys, wire ropes and booms;

(c) the position of blocks;

(d) the identification mark of individual items;

(e) arrangements and working range of union purchase.

2. Periodic examinations and re-testing

2.1 All lifting appliances and every item of loose gear shall be thoroughly examined by a competent person at least once in every 12 months. The particulars of these thorough examinations shall be entered in Part I of the Register.

2.2 Re-testing and thorough examination of all lifting appliances and every item of loose gear is to be carried out:

(a) after any substantial alteration or renewal, or after repair of any stress-bearing part; and

(b) in the case of lifting appliances at least once in every five years.

2.3 The re-testing referred to in paragraph 2.2(a) may be omitted provided the part which has been renewed or repaired is subjected by separate test, to the same stress as would have been imposed on it if it had been tested in situ during testing of the lifting appliance.

2.4 The thorough examinations and tests referred to in paragraph 2.2 are to be entered in Part I of the Register.

2.5 No new item of loose gear shall be manufactured of wrought iron. Heat treatment of any existing wrought iron components should be carried out to the satisfaction of the competent person. No heat treatment should be applied to any item of loose gear unless the treatment is in accordance with the manufacturer's instruction; to the satisfaction of the competent person. Any heat treatment and the associated examination are to be recorded by the competent person in Part I of the Register.

3. Inspections

3.1 Regular visual inspections of every item of loose gear shall be carried out by a responsible person before use. A record of these regular inspections is to be entered in Part II of the Register, but entries need only be made when the inspection has indicated a defect in the item.

4. Certificates

4.1 The certification forms to be used in conjunction with this Register (Form No. 1) are as follows:

Form No. 2	-	Certificate of test and thorough examination of lifting appliances.
Form No. 2 (U)	-	Certificate of test and thorough examination of derricks used in union purchase.
Form No. 3	-	Certificate of test and thorough examination of loose gear.
Form No. 4	-	Certificate of test and thorough examination of wire rope.

Definitions

(a) The term "competent authority" means a minister, government department or other authority empowered to issue regulations, orders or other instructions having the force of law.

(b) The term "competent person" means a person possessing the knowledge and experience required for the performance of thorough examinations and tests of lifting appliances and loose gear and who is acceptable to the competent authority.

(c) The term "responsible person" means a person appointed by the master of the ship or the owner of the gear to be responsible for the performance of inspections and has sufficient knowledge and experience to undertake such inspections.

(d) The term "thorough examination" means a detailed visual examination by a competent person, supplemented if necessary by other suitable means or measures in order to arrive at a reliable conclusion as to the safety of the lifting appliance or item of loose gear examined.

(e) The term "inspection" means a visual inspection carried out by a responsible person to decide whether, so far as can be ascertained in such manner, the loose gear or sling is safe for continued use.

(f) The term "lifting appliance" covers all stationary or mobile cargo-handling appliances used on board ship for suspending, raising or lowering loads or moving them from one position to another while suspended or supported.

MA (g) The term "loose gear" covers any gear by means of which a load can be attached to a lifting appliance but which does not form an integral part of the appliance or load.

3.

PART I - Thorough examination of lifting appliances and loose gear

(1) Situation and description of lifting appliances and loose gear (with distinguishing numbers or marks, if any) which have been thoroughly examined (see Note 1)	(2) Certificate Nos.	(3) Examination performed (see Note 2)	(4) I certify that on the date to which I have appended my signature, the gear shown in column (1) was thoroughly examined and no defects affecting its safe working condition were found other than those shown in column (5) (Date and signature)	(5) Remarks (To be dated and signed)

Note 1: If all the lifting appliances are thoroughly examined on the same date it will be sufficient to enter in column (1) "All lifting appliances and loose gear". If not, the parts which have been thoroughly examined on the dates stated must be clearly indicated.

Note 2: The thorough examinations to be indicated in column (3) include:

(a) Initial

(b) 12 monthly

(c) Five yearly

(d) Repair/damage

(e) Other thorough examinations including those associated with heat treatment.

4.

PART II - Regular inspections of loose gear

(1) Situation and description of loose gear (with distinguishing number or mark, if any) which has been inspected (see Note 1)	(2) Signature and date of the responsible person carrying out the inspection	(3) Remarks (To be dated and signed)

Note 1: All loose gear should be inspected before use. However, entries need only be made when the inspection discloses a defect.

Form No. 2

Identity of national authority or competent organisation

CERTIFICATE OF TEST AND THOROUGH
EXAMINATION OF LIFTING APPLIANCES

Name of Ship
Official Number
Call Sign
Port of Registry
Name of Owner

Certificate No. ....

(1)	(2)	(3)	(4)
Situation and description of lifting appliances (with distinguishing numbers or marks, if any) which have been tested and thoroughly examined	Angle to the horizontal or radius at which test load applied	Test load (tonnes)	Safe working load (SWL) at angle or radius shown in column 2 (tonnes)

Name and address of the firm or competent person who witnessed testing and carried out thorough examination ....
....
....

I certify that on the date to which I have appended my signature, the gear shown in column (1) was tested and thoroughly examined and no defects or permanent deformation were found; and that the safe working load is as shown.

Date: .... Signature: ....

Place: ....

Note: This Certificate is the standard international form as recommended by the International Labour Office in accordance with ILO Convention No. 152.

Instructions

1. Every lifting appliance shall be tested with a test load which shall exceed the safe working load (SWL) as follows:

SWL	Test load
Up to 20 tonnes	25 per cent in excess
20 to 50 tonnes	5 tonnes in excess
Over 50 tonnes	10 per cent in excess

2. In the case of derrick systems the test load shall be lifted with the ship's normal tackle with the derrick at the minimum angle to the horizontal for which the derrick system was designed (generally 15 degrees), or at such greater angle as may be agreed. The angle at which the test was made should be stated in the certificate of test. After the test load has been lifted it should be swung as far as possible in both directions.

2.1 The SWL shown is applicable to swinging derrick systems only. When derricks are used in union purchase the SWL (U) is to be as shown on Form 2 (U).

2.2 In the case of heavy derricks, care should be taken to ensure that the appropriate stays are correctly rigged.

3. In the case of cranes, the test load is to be hoisted, slewed and luffed at slow speed. Gantry and travelling cranes together with their trolleys, where appropriate, are to be traversed and travelled over the full length of their track.

3.1 In the case of variable load-radius cranes, the tests are generally to be carried out with the appropriate test load at maximum, minimum and at an intermediate radius.

3.2 In the case of hydraulic cranes where limitations of pressure make it impossible to lift a test load 25 per cent in excess of the safe working load, it will be sufficient to lift the greatest possible load, but in general this should not be less than 10 per cent in excess of the safe working load.

4. As a general rule, tests should be carried out using test loads, and no exception should be allowed in the case of initial tests. In the case of repairs, replacement or when the periodic examination calls for re-test, consideration may be given to the use of spring or hydraulic balances provided the SWL of the lifting appliance does not exceed 15 tonnes. Where a spring or hydraulic balance is used it shall be calibrated and accurate to within $\pm$ 2 per cent and the indicator should remain constant for five minutes.

4.1 If test weights are not used this is to be indicated in column (3).

5. The expression "tonne" shall mean a tonne of 1,000 kg.

6. The terms "competent person", "thorough examination" and "lifting appliance" are defined in Form No. 1.

Note: For recommendations on test procedures reference may be made to the ILO document Safety and Health in Dock Work.

Form No. 2 (U)

Identity of national authority or competent organisation

CERTIFICATE OF TEST AND THOROUGH EXAMINATION OF DERRICKS USED IN UNION PURCHASE

Name of Ship

Official Number

Call Sign

Port of Registry

Name of Owner

Certificate No. ....

(1)	(2)	(3)	(4)
Situation and description of derricks used in union purchase (with distinguishing numbers or marks) which have been tested and thoroughly examined	Maximum height of triangle plate above hatch coaming (m) or maximum angle between runners	Test load (tonnes)	Safe working load, SWL (U), when operating in union purchase (tonnes)

Position of outboard preventer guy attachments: (a) forward/aft* of mast .... (m)
and
(b) from ship's centre line .... (m)

Position of inboard preventer guy attachments: (a) forward/aft* of mast .... (m)
and
(b) from ship's centre line .... (m)

* Delete as appropriate

Name and address of the firm of competent person who witnessed testing and carried out thorough examination ....

....

....

I certify that on the date to which I have appended my signature, the gear shown in column (1) was tested and thoroughly examined and no defects or permanent deformation were found; and that the safe working load is as shown.

Date: ....   Signature: ....

Place: ....

Note: This Certificate is the standard international form as recommended by the International Labour Office in accordance with ILO Convention No. 152.

Instructions

1. Before being taken into use, the derricks rigged in union purchase shall be tested with a test load which shall exceed the safe working load (SWL (U)) as follows:

SWL	Test load
Up to 20 tonnes	25 per cent in excess
20 to 50 tonnes	5 tonnes in excess
Over 50 tonnes	10 per cent in excess

2. Tests are to be carried out at the approved maximum height of the triangle plate above the hatch coaming or at the angle between the cargo runners and with the derrick booms in their working positions, to prove the strength of deck eye plates and the union purchase system. These heights or angles must not exceed the values shown on the rigging plan.

3. Tests should be carried out using test loads.

4. The expression "tonne" shall mean a tonne of 1,000 kg.

5. The terms "competent person", "thorough examination" and "lifting appliance" are defined in Form No. 1.

Note: For recommendations on test procedures reference may be made to the ILO document Safety and Health in Dock Work.

Form No. 3

Identity of national authority or competent organisation

CERTIFICATE OF TEST AND THOROUGH EXAMINATION OF LOOSE GEAR

Name of Ship

Official Number

Call Sign

Port of Registry

Name of Owner

Certificate No. ....

Distinguishing number or mark	Description of loose gear	Number tested	Date of test	Test loaded (tonnes)	Safe working load (SWL) (tonnes)

Name and address of makers or suppliers: ....

Name and address of the firm or competent person who witnessed testing and carried out thorough examination ....
....
....

I certify that the above items of loose gear were tested and thoroughly examined and no defects affecting their SWL were found.

Date: .... Signature: ....

Place: ....

Note: This Certificate is the standard international form as recommended by the International Labour Office in accordance with ILO Convention No. 152.

Instructions

1. Every item of loose gear is to be tested and thoroughly examined before being put into use for the first time and after any substantial alteration or repair to any part liable to affect its safety. The test loads to be applied shall be in accordance with the following table:

Item	Test load (tonnes)
Single sheave blocks (see Note 1)	4 x SWL
Multi sheave blocks (see Note 2):	
SWL $\leq$ 25 tonnes	2 x SWL
25 tonnes < SWL $\leq$ 160 tonnes	(0.933 x SWL) + 27
SWL > 160 tonnes	1.1 x SWL
Chains, hooks, rings, shackles, swivels, etc.:	
SWL $\leq$ 25 tonnes	2 x SWL
SWL > 25 tonnes	(1.22 x SWL) + 20
Lifting beams, spreaders, frames and similar devices:	
SWL $\leq$ 10 tonnes	2 x SWL
10 tonnes < SWL $\leq$ 160 tonnes	(1.04 x SWL) + 9.6
SWL > 160 tonnes	1,1 x SWL

Note: 1. The SWL for a single sheave block, including single sheave blocks with beckets, is to be taken as one half of the resultant load on the head fitting.

2. The SWL of a multi-sheave block is to be taken as the resultant load on the head fitting.

2. This form may also be used for the certification of interchangeable components of lifting appliances.

3. The expression "tonne" shall mean a tonne of 1,000 kg.

4. The terms "competent person", "thorough examination" and "loose gear" are defined in Form No. 1.

Note: For recommendations on test procedures reference may be made to the ILO document Safety and Health in Dock Work.

Form No. 4

Identity of national authority or competent organisation

CERTIFICATE OF TEST AND THOROUGH EXAMINATION OF WIRE ROPE

Name of Ship — Certificate No. ....

Official Number

Call Sign

Port of Registry

Name of Owner

Name and address of maker or supplier

Nominal diameter of rope (mm)

Number of strands

Number of wires per strand

Core

Lay

Quality of wire (N/mm^2)

Date of test of sample

Load at which sample broke (tonnes)

Safe working load of rope (tonnes)

Intended use

Name and address of the firm or competent person who witnessed testing and carried out thorough examination ....

....

....

I certify that the above particulars are correct, and that the rope was tested and thoroughly examined and no defects affecting its SWL were found.

Date: .... Signature: ....

Place: ....

Note: This Certificate is the standard international form as recommended by the International Labour Office in accordance with ILO Convention No. 152.

Instructions

1. Wire rope shall be tested by sample, a piece being tested to destruction.

2. The test procedure should be in accordance with an international or recognised national standard.

3. The SWL of the rope is to be determined by dividing the load at which the sample broke, by a coefficient of utilisation, determined as follows:

Item	Coefficient
Wire rope forming part of a sling	
SWL of the sling:	
SWL $\leq$ 10 tonnes	5
10 tonnes $<$ SWL $\leq$ 160 tonnes	$\frac{10^4}{(8.85 \times SWL) + 1\,910}$
SWL $>$ 160 tonnes	3
Wire rope as integral part of a lifting appliance	
SWL of the lifting appliance:	
SWL $\leq$ 160 tonnes	$\frac{10^4}{(8.85 \times SWL) + 1\,910}$
SWL $>$ 160 tonnes	3

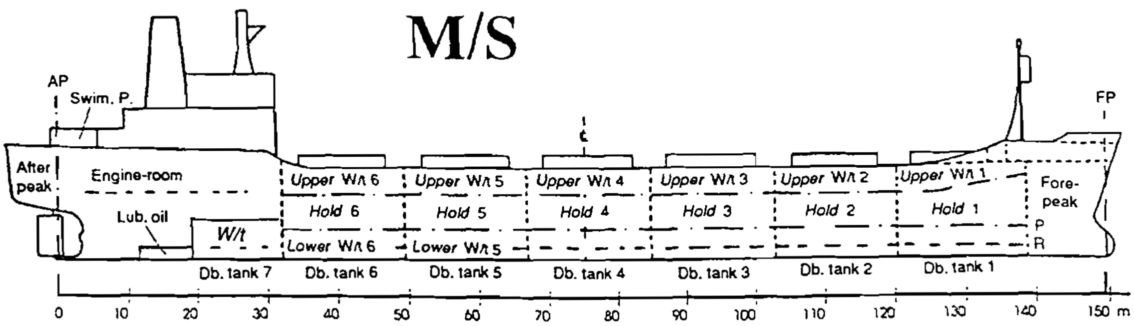
These coefficients should be adopted unless other requirements are specified by a national authority.

4. The expression "tonne" shall mean a tonne of 1,000 kg.

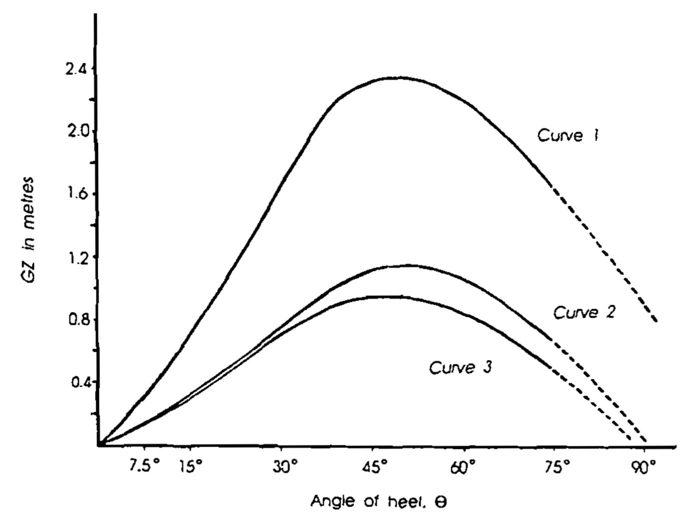
5. The terms "competent person", "thorough examination" and "lifting appliance" are defined in Form No. 1.

Note: For recommendations and test procedures reference may be made to the ILO document Safety and Health in Dock Work.

Appendix 2 – Hydrostatic data and capacity plan of a bulk carrier



Curves of statical stability



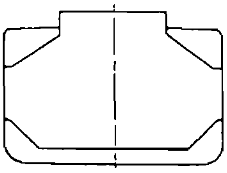
Curve	Condition	Cargo	H.O.	D.O.	Stores
1	Ballast	–	695.6	155.3	150
2	Load 1	14 894.3	250.0	53.5	150
3	Load 2	16 040.0	200.0	51.2	150

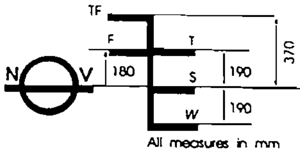
Curve	F/W	Ballast	L/S	Δ
1	263.3	5070.5	4895	11 229.7
2	104.8	672.4	4895	21 020
3	104.8	–	4895	21 441

Curve	KG	GG_1	Corrected KG	GM
1	6.54	–	6.54	2.56
2	7.113	0.043	7.156	1.484
3	7.320	0.043	7.363	1.307

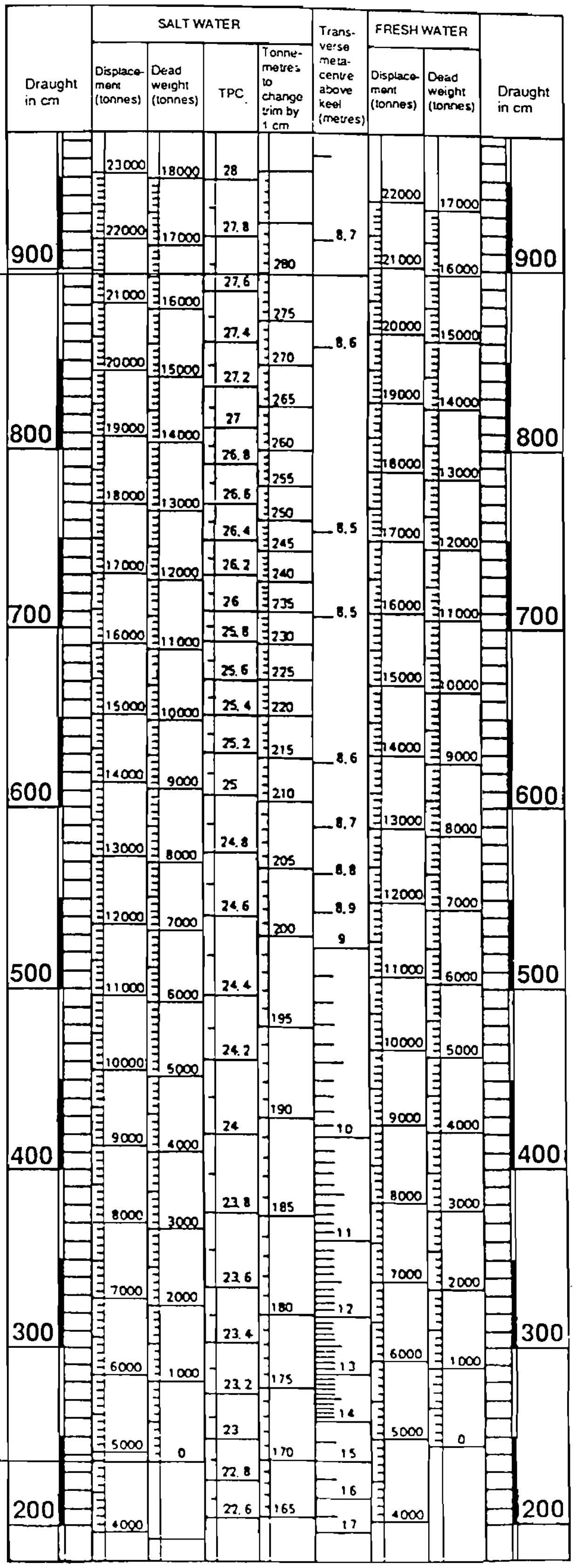
Capacities in tanks	Volume in m^3	Weights in tonnes					Centre of Gravity		Free surface
		Lub. oil (ρ = 0.9)	Diesel oil (ρ = 0.9)	Fuel oil (ρ = 0.95)	Fresh w. (ρ = 1.0)	Ballastw. (ρ = 1.02)	VCG (metres)	From AP (metres)	$I = \frac{l \times b^3}{12}$ m^4
Forepeak	268.4					275.1	7.28	142.77	67
Db. tank No. 1	2 × 214.0					438.7	1.49	128.44	495
Db. tank No. 2	2 × 296.0					606.8	1.19	110.64	2757
Db. tank No. 3	2 × 328.0					672.4	1.13	93.39	2936
Db. tank No. 4	2 × 328.0					672.4	1.13	75.80	2936
Db. tank No. 5	2 × 191.3			363.5		392.2	0.76	58.22	1094
Db. tank No. 6	2 × 174.8			332.1		358.3	0.76	40.78	785
Db. tank No. 7	2 × 86.3		155.3				1.34	24.69	81
Lower W/t. No. 5	2 × 136.1					279.0	1.76	58.46	81
Lower W/t. No. 6	2 × 100.8			191.5		206.6	1.89	40.63	55
W/t. Eng. Room	2 × 145			275.5			4.88	26.79	120
Upper W/t. No. 1	2 × 149.5					306.1	11.67	127.41	152
Upper W/t. No. 2	2 × 204.8					419.8	11.25	110.98	393
Upper W/t. No. 3	2 × 204.8					419.8	11.25	93.39	393
Upper W/t. No. 4	2 × 204.8					419.8	11.25	75.80	393
Upper W/t. No. 5	2 × 204.8					419.8	11.25	58.22	393
Upper W/t. No. 6	2 × 204.8					419.8	11.25	40.60	393
After-peak	158.5				158.5		7.98	3.44	206
Swim. pool	32				30	30.8	21.86	2.20	24
Freshw. tank	2 × 52.4				104.8		11.40	5.27	83
Daily diesel tank	52.2		47.0				10.76	15.00	39
Daily fuel oil tank	71.1			67.5			10.82	11.22	102
Diesel oil tank	6.0		5.4				13.99	28.53	1
Lub. oil tank	40.0	36.0					10.76	29.81	4
Lub. oil tank	2 × 20.8	37.4					0.67	20.60	20
Total:			207.7	1230.1	293.3	6307.1			

Loading scale





TF	17039 tonnes deadweight at 9.35 m			
F	16538	"	"	" 9.16 m
T	17057	"	"	" 9.17 m
S	16546	"	"	" 8.98 m
W	16037	"	"	" 8.79 m



Light ship 4895 tonnes
Mean draught 2.37 m in S W

Ships data

LOA = 159.4 m
LBP = 149.35 m
B = 20.4 m
D = 12.5 m
Gross = 11 182 tonnes
Net = 5 971 tonnes
Δ (s) = 21 441 tonnes
C_b (s) = 0.765

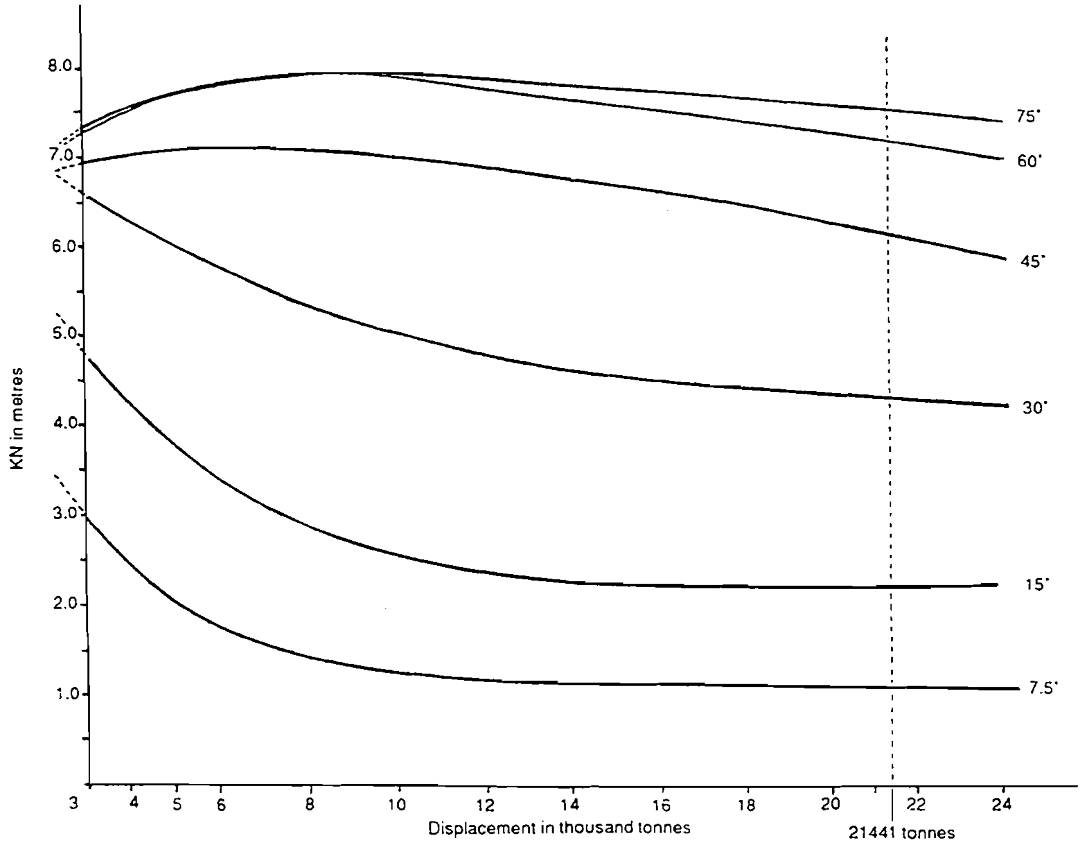
Light ship:

Displacement 4 895 tonnes
Draught F 0.25 m, A 4.62 m, M 2.43 m
VCG 7.8 m
LCG from AP 61.587 m

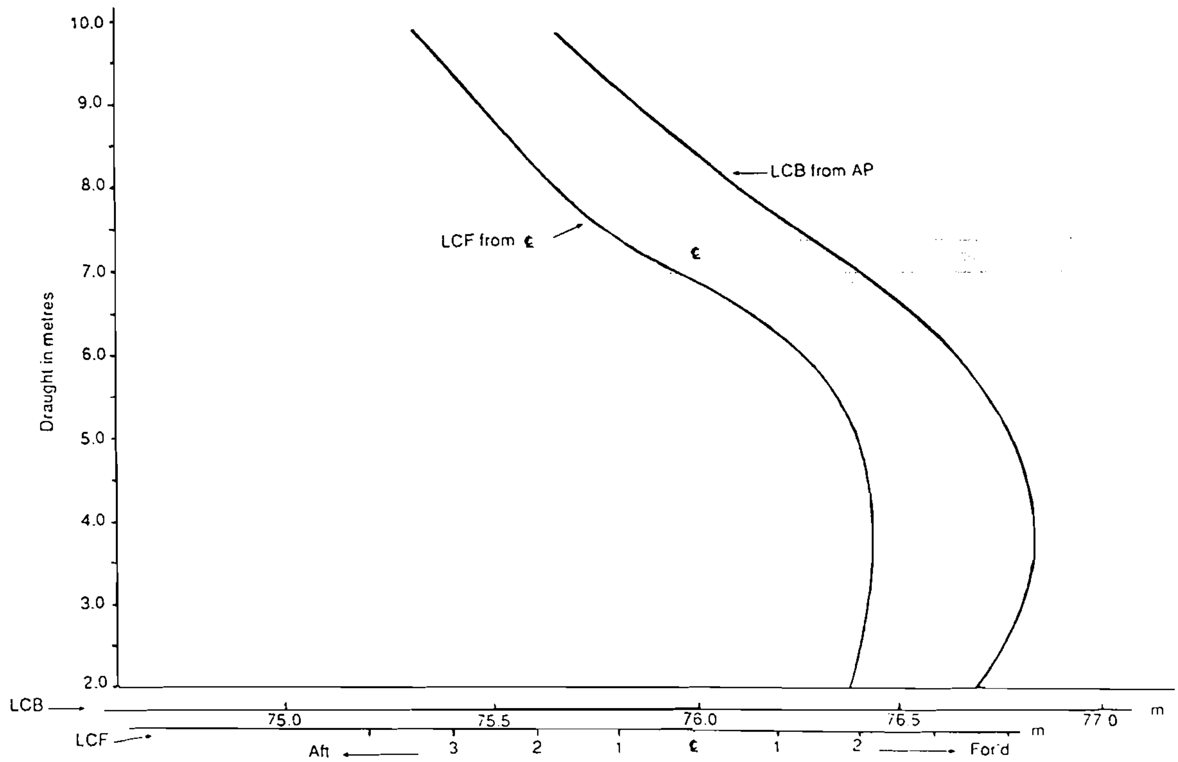
Cargo holds:

Hold No.	Volume (m^3) Grain	Bales	Centre of Gravity VCG (m)	from AP (m)
1	2 919	2 761	7.83	128.32
2	3 577	3 435	7.14	111.43
3	3 607	3 465	7.13	93.88
4	3 607	3 465	7.13	76.29
5	3 603	3 460	7.13	58.73
6	3 539	3 430	7.19	41.09
Total:	20 852	20 017		

KN Curves



KN in metres
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
75°
60°
45°
30°
15°
7.5°
3
4
5
6
8
10
12
14
16
18
20
22
24
Displacement in thousand tonnes
21441 tonnes



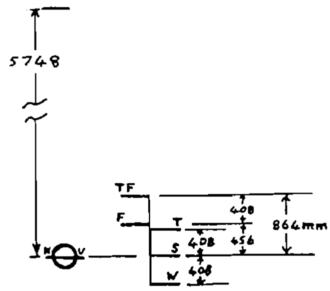
Draught in metres
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
LCB from AP
LCF from ℄
℄
LCB
LCF
75.0
75.5
76.0
76.5
77.0
m
Aft
3
2
1
℄
1
2
Ford

Appendix 3 – Hydrostatic data and ullage tables of a tanker

"VLCC"

Main particulars:

LOA = 327.00 m
Lpp = 313.000 m
B = 48.200 m
D = 25.200 m
d(s) = 19.507 m
DW(s) = 218344 tonnes
Δ(s) = 251244 tonnes
C_b(s) = 0.8322



Load Lines:

	Draught (m)	Freeboard (m)	Displacement (tonnes)	Deadweight (tonnes)
Tropical F.W.	20.371	4.884	256942	224042
Fresh water	19.963	5.292	251244	218344
Tropical	19.915	5.340	256942	224042
Summer	19.507	5.748	251244	218344
Winter	19.099	6.156	245546	212646

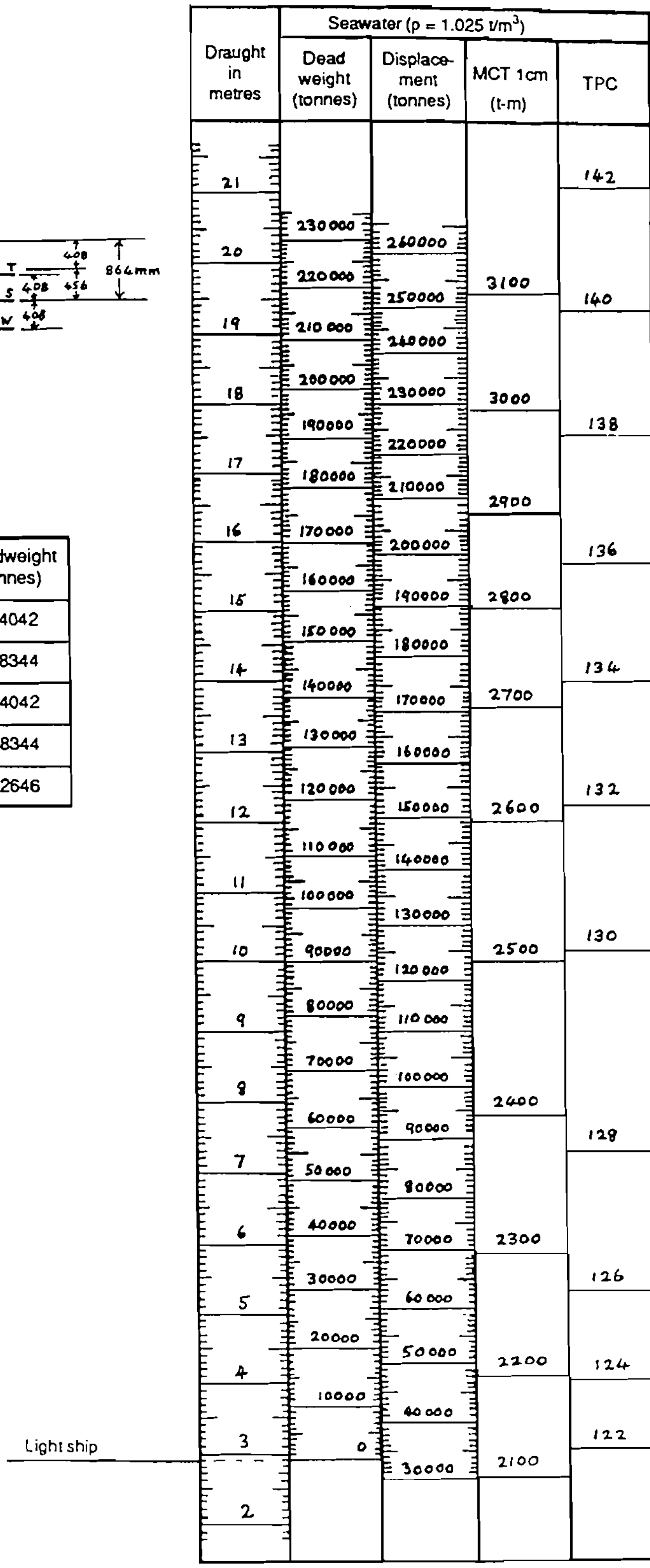
Light Ship:

LCG is 11.00m aft of L/2
WLS = ΔLS = 32900 tonnes
MLS = 0.5 (MLSF + MLSA) = –1324925 tonne -m
dm (even keel) = 2.883 m
LCB is 14.87m forward of L/2
LCF is 15.73m forward of L/2

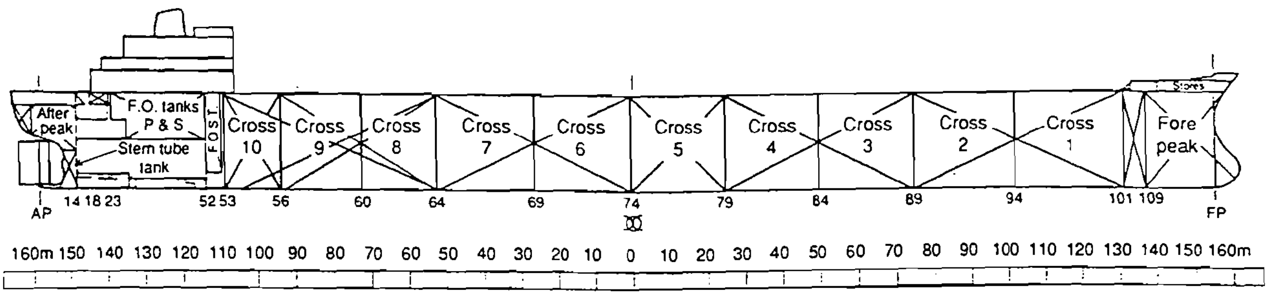
Light Ship Condition:

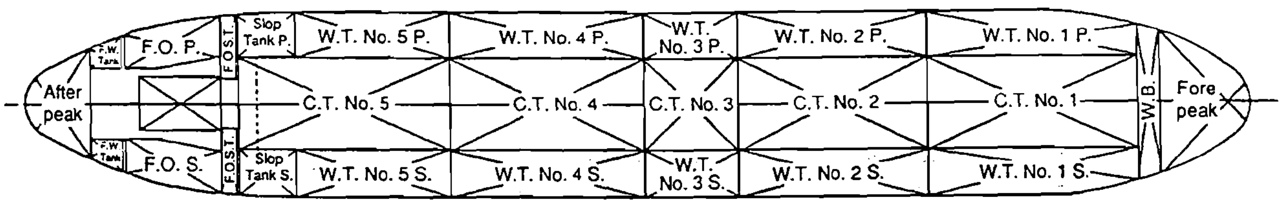
t = 4.145 m
dF = 0.996 m
dA = 5.141 m
dm = 3.067 m
SWBM = –344745 tonne -m

Loading Scale:



General arrangement:





Tank information:

Cargo tanks

Tank	Frame Nos.	Capacities (m^3, 100%)	LCG from L/2 (m)
C.T. No. 1	89–101	34717.2	104.15 F
C.T. No. 2	79–89	31449.7	50.50 F
C.T. No. 3	74–79	15274.9	12.25 F
C.T. No. 4	64–74	31449.7	25.98 A
C.T. No. 5	53–64	33222.0	78.49 A
TOTAL		146563.5	
W.T. No. 1 P.	89–101	15678.4	102.21 F
W.T. No. 2 P.	79–89	15594.9	50.50 F
W.T. No. 4 P.	64–74	15573.1	25.98 A
W.T. No. 5 P.	56–64	11329.0	71.08 A
Slop tank P.	53–56	3110.9	99.45 A
TOTAL P. & S.		122572.6	
Cargo total capacity		269136.1	

Fresh water and water ballast

Tank	Frame Nos.	Capacities (m^3, 100%)	LCG from L/2 (m)
F.W. tank P.	14–23	227.0	142.28 A
F.W. tank S.	14–18	124.4	144.27 A
F.W. tank P.	18–23	124.0	140.36 A
F.W. tank S.	18–23	124.0	140.36 A
After peak tank	Stern–14	1432.5	150.77 A
Fresh water total		2031.9	
Forepeak tank	109–stem	8963.3	145.91 F
W.B. tank	101–109	5173.6	135.22 F
W.T. No. 3 P.	74–79	7791.8	12.25 F
W.T. No. 3 S.	74–79	7791.8	12.25 F
Water ballast total		29720.5	

Fuel oil etc.

Tank	Frame Nos.	Capacities (m^3, 100%)	LCG from L/2 (m)
F.O. S.T. (P.)	52–52.7	774.3	110.43 A
F.O. S.T. (S.)	52–52.7	774.3	110.43 A
F.O. tank (P.)	24–52	2687.9	123.63 A
F.O. tank (S.)	24–52	2687.9	123.63 A
Fuel oil total		6924.4	
Stern tube tank	A.P.–14	58.9	147.93 A
L.O. tank	20–26	28.7	136.20 A
Stores A			134.00 A
Stores F	109–stem		143.70 F

Limits:

Bending moments and shear forces

Frame No.	Hogging moment (tonne-m)	Sagging moment (tonne-m)	Shear force (tonnes)
101	−162567	157487	10160
94	−381017	375937	7112
89	−492782	487703	8332
84	−553746	518184	8027
79	−553746	508024	7925
74	−553746	508024	7214
69	−553746	548665	9449
64	−553794	551714	12700
60	−472462	467382	10160
56	−386098	381018	8230
53	−325135	314975	9957
52	−284493	274333	9957

Hydrostatic Tables

Draught (m)	Displ. (tonnes)	TPC (tonnes)	MCT 1 cm (tonne-m)	LCB (m) for'd	LCF (m) for'd	KM (m)	KM_L (m)	KB (m)	Wetted surface (m^2)	C_b	A⊗ (m^2)	WP area (m^2)
2.5	28 410	120.7	2090	15.87	15.07	70.55	2331	1.28	12 540	0.721	115.3	11782
3.0	34 483	121.8	2127	15.71	14.81	60.37	1962	1.54	12 936	0.736	139.5	11894
3.5	40 502	122.9	2162	15.55	14.54	52.35	1692	1.80	13 292	0.746	163.7	11990
4.0	46 575	123.9	2194	15.39	14.26	46.33	1487	2.05	13 641	0.752	187.8	12073
4.5	52 694	124.8	2224	15.24	13.96	41.78	1331	2.31	13 985	0.758	211.9	12143
5.0	58 870	125.6	2253	15.08	13.66	38.18	1206	2.57	14 326	0.763	236.0	12213
5.5	65 107	126.2	2281	14.93	13.32	35.25	1103	2.82	14 666	0.768	260.0	12274
6.0	71 405	126.8	2308	14.77	12.98	32.89	1018	3.08	15 005	0.772	284.1	12331
6.5	77 759	127.3	2333	14.61	12.63	30.92	945	3.34	15 343	0.775	308.3	12383
7.0	84 183	127.8	2362	14.44	12.27	29.25	883	3.59	15 681	0.779	332.4	12431
7.5	90 647	128.2	2386	14.27	11.91	27.86	830	3.85	16 018	0.782	356.5	12475
8.0	97 146	128.5	2410	14.11	11.53	26.66	783	4.11	16 354	0.783	380.5	12515
8.5	103 597	128.8	2433	13.93	11.14	25.55	741	4.36	16 691	0.788	404.7	12553
9.0	110 217	129.2	2455	13.76	10.74	24.74	705	4.62	17 026	0.790	428.7	12589
9.5	116 513	129.6	2478	13.58	10.32	23.97	672	4.87	17 361	0.792	452.8	12624
10.0	123 006	129.9	2500	13.39	9.88	23.31	643	5.13	17 698	0.795	477.0	12660
10.5	129 505	130.3	2522	13.20	9.42	22.73	617	5.39	18 033	0.797	501.1	12697
11.0	136 042	130.8	2546	13.02	8.95	22.25	593	5.64	18 369	0.799	525.1	12737
11.5	142 633	131.2	2572	12.81	8.41	21.80	572	5.90	18 706	0.801	549.2	12780
12.0	149 167	131.8	2599	12.60	7.87	21.43	554	6.16	19 044	0.803	573.4	12827
12.5	155 773	132.3	2629	12.39	7.30	21.11	536	6.42	19 382	0.805	597.6	12877
13.0	162 410	132.8	2659	12.17	6.71	20.85	521	6.67	19 721	0.807	621.6	12932
13.5	169 009	133.4	2691	11.94	6.11	20.62	507	6.93	20 058	0.809	645.6	12989
14.0	175 745	134.0	2726	11.70	5.48	20.42	494	7.19	20 400	0.811	669.7	13049
14.5	182 468	134.6	2762	11.46	4.85	20.27	482	7.45	20 740	0.813	693.8	13111
15.0	189 202	135.2	2799	11.21	4.23	20.13	472	7.71	21 081	0.815	718.0	13174
15.5	195 968	135.8	2835	10.96	3.61	20.03	461	7.97	21 420	0.817	742.0	13236
16.0	202 757	136.4	2872	10.70	3.02	19.95	452	8.23	21 759	0.819	766.2	13296
16.5	209 575	137.0	2908	10.45	2.45	19.89	443	8.49	22 098	0.820	790.2	13355
17.0	216 431	137.5	2942	10.18	1.92	19.85	435	8.75	22 434	0.822	814.3	13410
17.5	223 322	138.0	2976	9.92	1.43	19.82	427	9.01	22 770	0.824	838.4	13463
18.0	230 244	138.6	3008	9.66	0.98	19.81	419	9.28	23 105	0.826	862.6	13513
18.5	237 181	139.2	3038	9.40	0.58	19.81	411	9.54	23 438	0.828	886.7	13561
19.0	244 149	139.7	3068	9.14	0.24	19.83	404	9.80	23 770	0.830	910.7	13608
19.5	251 147	140.2	3096	8.88	−0.07	19.86	397	10.06	24 103	0.832	934.8	13653
20.0	258 173	140.7	3124	8.64	−0.33	19.90	390	10.33	24 433	0.833	958.9	13701
20.5	265 186	141.2	3150	8.39	−0.65	19.94	383	10.59	24 764	0.834	983.1	13748

Ullage Tables

Ullage (metres)	Capacity of tank (m^3) 1C	2C	3C	4C	5C	1W	2W	3W	4W	5W	SLOP
0.00	34717	31450	15725	31450	33222	15678	15595	7792	15573	11329	3111
0.10	34594	31344	15672	31344	33109	15650	15568	7784	15548	11307	3105
0.20	34494	31246	15623	31246	33001	15637	15552	7775	15531	11292	3099
0.30	34360	31124	15562	31124	32866	15608	15526	7762	15504	11270	3091
0.40	34225	31001	15500	31001	32732	15573	15490	7743	15467	11240	3080
0.50	34091	30880	15439	30880	32598	15530	15442	7718	15428	11206	3065
0.52	34064	30855	15427	30855	32571	15520	15430	7712	15416	11196	3062
0.54	34037	30830	15415	30830	32544	15510	15417	7706	15403	11186	3059
0.56	34010	30806	15402	30806	32518	15499	15404	7699	15381	11177	3056
0.58	33983	30781	15390	30781	32491	15488	15391	7693	15368	11167	3052
0.60	33956	30757	15378	30757	32465	15477	15379	7687	15356	11157	3048
0.61	33943	30744	15372	30744	32452	15470	15373	7683	15350	11152	3046
0.62	33929	30732	15366	30732	32439	15464	15366	7680	15344	11147	3045
0.63	33916	30720	15360	30720	32425	15457	15360	7677	15337	11142	3043
0.64	33902	30707	15354	30707	32412	15450	15354	7674	15331	11137	3041
0.65	33889	30695	15347	30695	32399	15443	15348	7671	15325	11132	3039
0.66	33875	30683	15341	30683	32385	15437	15342	7668	15319	11127	3037
0.67	33862	30670	15335	30670	32372	15430	15335	7665	15312	11122	3036
0.68	33848	30658	15329	30658	32359	15423	15329	7662	15306	11118	3034
0.69	33835	30646	15323	30646	32345	15416	15323	7659	15300	11113	3032
0.70	33821	30634	15317	30634	32332	15410	15317	7656	15294	11108	3030
0.71	33808	30621	15311	30621	32319	15403	15311	7653	15287	11103	3028
0.72	33794	30609	15304	30609	32305	15396	15304	7650	15281	11098	3027
0.73	33781	30597	15298	30597	32292	15389	15298	7647	15275	11093	3025
0.74	33767	30584	15292	30584	32279	15383	15292	7643	15269	11088	3023
0.75	33754	30572	15286	30572	32265	15376	15286	7640	15262	11083	3021
0.76	33740	30560	15280	30560	32252	15369	15280	7637	15256	11078	3019
0.77	33727	30548	15274	30548	32239	15362	15273	7634	15250	11073	3018
0.78	33713	30535	15268	30535	32225	15356	15267	7631	15244	11068	3016
0.79	33700	30523	15261	30523	32212	15349	15261	7628	15237	11063	3014
0.80	33686	30511	15255	30511	32199	15342	15255	7625	15231	11058	3012
0.81	33673	30498	15249	30498	32185	15335	15249	7622	15225	11053	3010
0.82	33659	30486	15243	30486	32172	15329	15242	7619	15219	11049	3009
0.83	33646	30474	15237	30474	32159	15322	15236	7616	15212	11044	3007
0.84	33632	30462	15231	30462	32145	15315	15230	7613	15206	11039	3005
0.85	33619	30449	15225	30449	32132	15308	15224	7610	15200	11034	3003
0.86	33605	30437	15218	30437	32119	15302	15218	7607	15194	11029	3001
0.87	33592	30425	15212	30425	32104	15295	15211	7604	15188	11024	3000
0.88	33578	30412	15206	30412	32091	15288	15205	7600	15181	11019	2998
0.89	33565	30400	15200	30400	32078	15281	15199	7597	15176	11014	2996
0.90	33552	30388	15194	30388	32064	15275	15193	7594	15169	11009	2994
0.92	33525	30364	15182	30364	32038	15260	15161	7588	15153	10999	2991
0.94	33498	30340	15170	30340	32011	15245	15154	7582	15134	10989	2988
0.96	33471	30315	15157	30315	31985	15229	15146	7575	15122	10980	2985
0.98	33444	30291	15145	30291	31958	15214	15139	7569	15107	10970	2982
1.00	33417	30266	15133	30266	31931	15199	15131	7563	15091	10960	2979
1.10	33282	30143	15072	30143	31797	15138	15068	7532	15037	10911	2962
1.20	33147	30020	15010	30020	31663	15078	15006	7501	14982	10862	2944

Tables for calculating shear force and bending moments

Draught (m)	Buoyancy characteristics of sections, in tonnes												
	Fore Peak	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	Eng. Room
3	1372	3380	3936	3690	3690	3690	3690	3635	2606	2206	1183	301	1091
4	1893	4582	5275	4940	4940	4940	4940	4877	3526	3025	1645	422	1534
5	2445	5819	6618	6194	6194	6194	6194	6125	4465	3878	2138	552	2015
6	3027	7086	7970	7451	7451	7451	7451	7384	5424	4769	2661	692	2534
7	3639	8388	9326	8714	8714	8714	8714	8651	6406	5699	3217	841	3092
8	4282	9730	10703	9991	9991	9991	9991	9936	7414	6668	3807	1003	3692
9	4875	11042	12057	11252	11252	11252	11252	11199	8394	7620	4395	1164	4331
10	5456	12358	13412	12513	12513	12513	12513	12460	9372	8582	5000	1333	5012
11	6031	13680	14768	13773	13773	13773	13773	13720	10352	9556	5622	1508	5729
12	6601	15012	16122	15034	15034	15034	15034	14981	11334	10546	6262	1691	6499
13	7160	16382	17477	16294	16294	16294	16294	16242	12319	11535	6910	1878	7380
14	7710	17671	18832	17553	17553	17553	17553	17503	13305	12530	7569	2071	8344
15	8254	19005	20187	18814	18814	18814	18814	18765	14292	13533	8243	2269	9392
16	8789	20341	21542	20074	20074	20074	20074	20025	15282	14543	8929	2474	10516
17	9337	21679	22898	21334	21334	21334	21334	21286	16269	15553	9618	2681	11747
18	9889	23018	24252	22594	22594	22594	22594	22548	17258	16567	10317	2894	13079
19	10442	24360	25607	23855	23855	23855	23855	23809	18245	17584	11026	3109	14500
20	10998	25703	26964	25115	25115	25115	25115	25069	19234	18606	11742	3330	16012

Trim (m)	Buoyancy corrections due to trim, in tonnes												
	Fore Peak	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	Eng. Room
5A	-1233	-2548	-1944	-1274	-757	-247	269	781	971	1315	1083	354	2522
4A	-983	-2039	-1555	-1019	-609	-197	214	626	777	1053	865	282	1976
3A	-735	-1531	-1167	-765	-456	-148	161	469	583	791	649	211	1451
2A	-487	-1020	-777	-509	-304	-99	107	313	389	526	432	140	942
1A	-244	-513	-390	-256	-152	-49	53	156	194	263	216	69	463
0.5F	120	254	195	126	77	25	-26	-78	-97	-132	-107	-36	-224
1F	240	511	388	254	152	50	-53	-156	-194	-262	-213	-68	-444
2F	483	1022	777	509	304	98	-107	-313	-388	-523	-426	-137	-875
2.5F	607	1278	970	637	379	123	-133	-391	-485	-653	-530	-170	-1086

Weight of sections, in tonnes

2545	2369	2380	2475	2475	2475	2551	2551	2041	2014	1586	658	6777

Length of sections, in metres

(24.5)	28.9	27.4	25.5	25.5	25.5	25.5	25.5	20.0	20.8	15.0	4.8	(44.4)

Appendix 4 – Extracts from API/IP/ASTM Petroleum Measurement Tables

Table 1
Interrelation of Units of Measurement

LENGTH

To Convert	Multiply By
Meters:	
To Yards	1.0936
To Feet	3.2808
To Inches	39.370
Yards:	
To Meters	0.91440
Feet:	
To Meters	0.30480
Inches:	
To Centimeters	2.5400

WEIGHT

To Convert	Multiply By
Long Tons:	
To Pounds (Avoirdupois)	2240
To Short Tons	1.12
To Metric Tons (Tonnes)	1.01605
Short Tons:	
To Pounds (Avoirdupois)	2000
To Long Tons	0.892857
To Metric Tons (Tonnes)	0.907185
Metric Tons (Tonnes):	
To Long Tons	0.98421
To Short Tons	1.10231
Pounds (Avoirdupois):	
To Kilograms	0.453592
Kilograms:	
To Pounds (Avoirdupois)	2.20462

VOLUME AND CAPACITY*

To Convert	Multiply By
U.S. Gallons:	
To Cubic Inches	231†
To Cubic Feet	0.133681
To Imperial Gallons	0.83268
To U.S. Barrels	0.0238095
To Liters	3.78533
U.S. Barrels:	
To U.S. Gallons	42†
To Cubic Inches	9702†
To Cubic Feet	5.6146
To Imperial Gallons	34.9726
To Liters	158.984
Imperial Gallons:	
To Cubic Inches	277.42
To Cubic Feet	0.160544
To U.S. Gallons	1.20094
To U.S. Barrels	0.028594
To Liters	4.54596
Cubic Feet:	
To Imperial Gallons	6.2288
To U.S. Gallons	7.4805
To U.S. Barrels	0.17811
To Liters	28.316
To Cubic Meters	0.028317
Cubic Inches:	
To Imperial Gallons	0.00360463
To U.S. Gallons	0.0043290
To Liters	0.016387
Liters:	
To Cubic Inches	61.026
To Cubic Feet	0.035316
To Imperial Gallons	0.219975
To U.S. Gallons	0.264178
To U.S. Barrels	0.0062900
Cubic Meters:	
To Imperial Gallons	219.97
To U.S. Gallons	264.17
To U.S. Barrels	6.2898
To Cubic Feet	35.315

* These factors are solely for conversion at the same temperature.
† This relationship is exact by definition.

Table 2

Temperature Conversions

°C		°F	°C		°F	°C		°F
−17.8	0	32.0	10.0	50	122.0	37.8	100	212.0
−17.2	1	33.8	10.6	51	123.8	38.3	101	213.8
−16.7	2	35.6	11.1	52	125.6	38.9	102	215.6
−16.1	3	37.4	11.7	53	127.4	39.4	103	217.4
−15.6	4	39.2	12.2	54	129.2	40.0	104	219.2
−15.0	5	41.0	12.8	55	131.0	40.6	105	221.0
−14.4	6	42.8	13.3	56	132.8	41.1	106	222.8
−13.9	7	44.6	13.9	57	134.6	41.7	107	224.6
−13.3	8	46.4	14.4	58	136.4	42.2	108	226.4
−12.8	9	48.2	15.0	59	138.2	42.8	109	228.2
−12.2	10	50.0	15.6	60	140.0	43.3	110	230.0
−11.7	11	51.8	16.1	61	141.8	43.9	111	231.8
−11.1	12	53.6	16.7	62	143.6	44.4	112	233.6
−10.6	13	55.4	17.2	63	145.4	45.0	113	235.4
−10.0	14	57.2	17.8	64	147.2	45.6	114	237.2
− 9.4	15	59.0	18.3	65	149.0	46.1	115	239.0
− 8.9	16	60.8	18.9	66	150.8	46.7	116	240.8
− 8.3	17	62.6	19.4	67	152.6	47.2	117	242.6
− 7.8	18	64.4	20.0	68	154.4	47.8	118	244.4
− 7.2	19	66.2	20.6	69	156.2	48.3	119	246.2
− 6.7	20	68.0	21.1	70	158.0	48.9	120	248.0
− 6.1	21	69.8	21.7	71	159.8	49.4	121	249.8
− 5.6	22	71.6	22.2	72	161.6	50.0	122	251.6
− 5.0	23	73.4	22.8	73	163.4	50.6	123	253.4
− 4.4	24	75.2	23.3	74	165.2	51.1	124	255.2
− 3.9	25	77.0	23.9	75	167.0	51.7	125	257.0
− 3.3	26	78.8	24.4	76	168.8	52.2	126	258.8
− 2.8	27	80.6	25.0	77	170.6	52.8	127	260.6
− 2.2	28	82.4	25.6	78	172.4	53.3	128	262.4
− 1.7	29	84.2	26.1	79	174.2	53.9	129	264.2
− 1.1	30	86.0	26.7	80	176.0	54.4	130	266.0
− 0.6	31	87.8	27.2	81	177.8	55.0	131	267.8
0.0	32	89.6	27.8	82	179.6	55.6	132	269.6
0.6	33	91.4	28.3	83	181.4	56.1	133	271.4
1.1	34	93.2	28.9	84	183.2	56.7	134	273.2
1.7	35	95.0	29.4	85	185.0	57.2	135	275.0
2.2	36	96.8	30.0	86	186.8	57.8	136	276.8
2.8	37	98.6	30.6	87	188.6	58.3	137	278.6
3.3	38	100.4	31.1	88	190.4	58.9	138	280.4
3.9	39	102.2	31.7	89	192.2	59.4	139	282.2
4.4	40	104.0	32.2	90	194.0	60.0	140	284.0
5.0	41	105.8	32.8	91	195.8	60.6	141	285.8
5.6	42	107.6	33.3	92	197.6	61.1	142	287.6
6.1	43	109.4	33.9	93	199.4	61.7	143	289.4
6.7	44	111.2	34.4	94	201.2	62.2	144	291.2
7.2	45	113.0	35.0	95	203.0	62.8	145	293.0
7.8	46	114.8	35.6	96	204.8	63.3	146	294.8
8.3	47	116.6	36.1	97	206.6	63.9	147	296.6
8.9	48	118.4	36.7	98	208.4	64.4	148	298.4
9.4	49	120.2	37.2	99	210.2	65.0	149	300.2
10.0	50	122.0	37.8	100	212.0	65.6	150	302.0

The temperature to be converted from degrees Fahrenheit to degrees Celsius, or vice versa, is found in the central column and the converted temperature is read to the left for degrees Celsius or to the right for degrees Fahrenheit.

TABLE 54A. GENERALIZED CRUDE OILS
VOLUME CORRECTION TO 15 C

DENSITY AT 15 C

FACTOR FOR CORRECTING VOLUME TO 15 C

TEMP. C	790.0	792.0	794.0	796.0	798.0	800.0	802.0	804.0	806.0	808.0	810.0	TEMP. C
10.00	1.0049	1.0049	1.0049	1.0048	1.0048	1.0048	1.0048	1.0047	1.0047	1.0047	1.0047	10.00
10.25	1.0047	1.0046	1.0046	1.0046	1.0046	1.0046	1.0045	1.0045	1.0045	1.0045	1.0044	10.25
10.50	1.0044	1.0044	1.0044	1.0044	1.0043	1.0043	1.0043	1.0043	1.0042	1.0042	1.0042	10.50
10.75	1.0042	1.0042	1.0041	1.0041	1.0041	1.0041	1.0041	1.0040	1.0040	1.0040	1.0040	10.75
11.00	1.0039	1.0039	1.0039	1.0039	1.0039	1.0038	1.0038	1.0038	1.0038	1.0038	1.0037	11.00
11.25	1.0037	1.0037	1.0036	1.0036	1.0036	1.0036	1.0036	1.0036	1.0035	1.0035	1.0035	11.25
11.50	1.0034	1.0034	1.0034	1.0034	1.0034	1.0034	1.0033	1.0033	1.0033	1.0033	1.0033	11.50
11.75	1.0032	1.0032	1.0032	1.0031	1.0031	1.0031	1.0031	1.0031	1.0031	1.0031	1.0030	11.75
12.00	1.0029	1.0029	1.0029	1.0029	1.0029	1.0029	1.0029	1.0028	1.0028	1.0028	1.0028	12.00
12.25	1.0027	1.0027	1.0027	1.0027	1.0026	1.0026	1.0026	1.0026	1.0026	1.0026	1.0026	12.25
12.50	1.0025	1.0024	1.0024	1.0024	1.0024	1.0024	1.0024	1.0024	1.0024	1.0023	1.0023	12.50
12.75	1.0022	1.0022	1.0022	1.0022	1.0022	1.0022	1.0021	1.0021	1.0021	1.0021	1.0021	12.75
13.00	1.0020	1.0020	1.0019	1.0019	1.0019	1.0019	1.0019	1.0019	1.0019	1.0019	1.0019	13.00
13.25	1.0017	1.0017	1.0017	1.0017	1.0017	1.0017	1.0017	1.0017	1.0017	1.0016	1.0016	13.25
13.50	1.0015	1.0015	1.0015	1.0015	1.0014	1.0014	1.0014	1.0014	1.0014	1.0014	1.0014	13.50
13.75	1.0012	1.0012	1.0012	1.0012	1.0012	1.0012	1.0012	1.0012	1.0012	1.0012	1.0012	13.75
14.00	1.0010	1.0010	1.0010	1.0010	1.0010	1.0010	1.0010	1.0009	1.0009	1.0009	1.0009	14.00
14.25	1.0007	1.0007	1.0007	1.0007	1.0007	1.0007	1.0007	1.0007	1.0007	1.0007	1.0007	14.25
14.50	1.0005	1.0005	1.0005	1.0005	1.0005	1.0005	1.0005	1.0005	1.0005	1.0005	1.0005	14.50
14.75	1.0002	1.0002	1.0002	1.0002	1.0002	1.0002	1.0002	1.0002	1.0002	1.0002	1.0002	14.75
15.00	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	15.00
15.25	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	15.25
15.50	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	15.50
15.75	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993	15.75
16.00	0.9990	0.9990	0.9990	0.9990	0.9990	0.9990	0.9990	0.9990	0.9991	0.9991	0.9991	16.00
16.25	0.9988	0.9988	0.9988	0.9988	0.9988	0.9988	0.9988	0.9988	0.9988	0.9988	0.9988	16.25
16.50	0.9985	0.9985	0.9985	0.9985	0.9986	0.9986	0.9986	0.9986	0.9986	0.9986	0.9986	16.50
16.75	0.9983	0.9983	0.9983	0.9983	0.9983	0.9983	0.9983	0.9983	0.9983	0.9984	0.9984	16.75
17.00	0.9980	0.9980	0.9981	0.9981	0.9981	0.9981	0.9981	0.9981	0.9981	0.9981	0.9981	17.00
17.25	0.9978	0.9978	0.9978	0.9978	0.9978	0.9978	0.9979	0.9979	0.9979	0.9979	0.9979	17.25
17.50	0.9975	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9977	17.50

* DENOTES EXTRAPOLATED VALUE

DENSITY = 790.0 TO 810.0

TABLE 54A, GENERALIZED CRUDE OILS
VOLUME CORRECTION TO 15 C

TEMP. C	DENSITY AT 15 C: 790.0	792.0	794.0	796.0	798.0	800.0	802.0	804.0	806.0	808.0	810.0	TEMP. C
	FACTOR FOR CORRECTING VOLUME TO 15 C											
17.50	0.9975	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9977	17.50
17.75	0.9973	0.9973	0.9973	0.9973	0.9973	0.9974	0.9974	0.9974	0.9974	0.9974	0.9974	17.75
18.00	0.9970	0.9971	0.9971	0.9971	0.9971	0.9971	0.9971	0.9971	0.9972	0.9972	0.9972	18.00
18.25	0.9968	0.9968	0.9968	0.9968	0.9969	0.9969	0.9969	0.9969	0.9969	0.9969	0.9970	18.25
18.50	0.9966	0.9966	0.9966	0.9966	0.9966	0.9966	0.9967	0.9967	0.9967	0.9967	0.9967	18.50
18.75	0.9963	0.9963	0.9963	0.9964	0.9964	0.9964	0.9964	0.9964	0.9965	0.9965	0.9965	18.75
19.00	0.9961	0.9961	0.9961	0.9961	0.9961	0.9962	0.9962	0.9962	0.9962	0.9962	0.9963	19.00
19.25	0.9958	0.9958	0.9959	0.9959	0.9959	0.9959	0.9959	0.9960	0.9960	0.9960	0.9960	19.25
19.50	0.9956	0.9956	0.9956	0.9956	0.9957	0.9957	0.9957	0.9957	0.9957	0.9958	0.9958	19.50
19.75	0.9953	0.9953	0.9954	0.9954	0.9954	0.9954	0.9955	0.9955	0.9955	0.9955	0.9955	19.75
20.00	0.9951	0.9951	0.9951	0.9951	0.9952	0.9952	0.9952	0.9952	0.9953	0.9953	0.9953	20.00
20.25	0.9948	0.9949	0.9949	0.9949	0.9949	0.9950	0.9950	0.9950	0.9950	0.9951	0.9951	20.25
20.50	0.9946	0.9946	0.9946	0.9947	0.9947	0.9947	0.9947	0.9948	0.9948	0.9948	0.9948	20.50
20.75	0.9943	0.9944	0.9944	0.9944	0.9944	0.9945	0.9945	0.9945	0.9946	0.9946	0.9946	20.75
21.00	0.9941	0.9941	0.9941	0.9942	0.9942	0.9942	0.9943	0.9943	0.9943	0.9943	0.9944	21.00
21.25	0.9938	0.9939	0.9939	0.9939	0.9940	0.9940	0.9940	0.9941	0.9941	0.9941	0.9941	21.25
21.50	0.9936	0.9936	0.9937	0.9937	0.9937	0.9938	0.9938	0.9938	0.9938	0.9939	0.9939	21.50
21.75	0.9933	0.9934	0.9934	0.9934	0.9935	0.9935	0.9935	0.9936	0.9936	0.9936	0.9937	21.75
22.00	0.9931	0.9931	0.9932	0.9932	0.9932	0.9933	0.9933	0.9933	0.9934	0.9934	0.9934	22.00
22.25	0.9929	0.9929	0.9929	0.9930	0.9930	0.9930	0.9931	0.9931	0.9931	0.9932	0.9932	22.25
22.50	0.9926	0.9926	0.9927	0.9927	0.9928	0.9928	0.9928	0.9929	0.9929	0.9929	0.9930	22.50
22.75	0.9924	0.9924	0.9924	0.9925	0.9925	0.9925	0.9926	0.9926	0.9927	0.9927	0.9927	22.75
23.00	0.9921	0.9922	0.9922	0.9922	0.9923	0.9923	0.9923	0.9924	0.9924	0.9925	0.9925	23.00
23.25	0.9919	0.9919	0.9919	0.9920	0.9920	0.9921	0.9921	0.9921	0.9922	0.9922	0.9923	23.25
23.50	0.9916	0.9917	0.9917	0.9917	0.9918	0.9918	0.9919	0.9919	0.9919	0.9920	0.9920	23.50
23.75	0.9914	0.9914	0.9915	0.9915	0.9915	0.9916	0.9916	0.9917	0.9917	0.9918	0.9918	23.75
24.00	0.9911	0.9912	0.9912	0.9913	0.9913	0.9913	0.9914	0.9914	0.9915	0.9915	0.9916	24.00
24.25	0.9909	0.9909	0.9910	0.9910	0.9911	0.9911	0.9911	0.9912	0.9912	0.9913	0.9913	24.25
24.50	0.9906	0.9907	0.9907	0.9908	0.9908	0.9909	0.9909	0.9910	0.9910	0.9910	0.9911	24.50
24.75	0.9904	0.9904	0.9905	0.9905	0.9906	0.9906	0.9907	0.9907	0.9908	0.9908	0.9909	24.75
25.00	0.9901	0.9902	0.9902	0.9903	0.9903	0.9904	0.9904	0.9905	0.9905	0.9906	0.9906	25.00

* DENOTES EXTRAPOLATED VALUE

DENSITY = 790.0 TO 810.0

This Table must be used with a value of density at 15°C (see Table 53A) and with an observed temperature

TABLE 54A. GENERALIZED CRUDE OILS
VOLUME CORRECTION TO 15 C

DENSITY AT 15 C
FACTOR FOR CORRECTING VOLUME TO 15 C

TEMP. C	790.0	792.0	794.0	796.0	798.0	800.0	802.0	804.0	806.0	808.0	810.0	TEMP. C
25.00	0.9901	0.9902	0.9902	0.9903	0.9903	0.9904	0.9904	0.9905	0.9905	0.9906	0.9906	25.00
25.25	0.9899	0.9899	0.9900	0.9900	0.9901	0.9901	0.9902	0.9902	0.9903	0.9903	0.9904	25.25
25.50	0.9896	0.9897	0.9897	0.9898	0.9898	0.9899	0.9899	0.9900	0.9900	0.9901	0.9901	25.50
25.75	0.9894	0.9894	0.9895	0.9896	0.9896	0.9897	0.9897	0.9898	0.9898	0.9899	0.9899	25.75
26.00	0.9891	0.9892	0.9893	0.9893	0.9894	0.9894	0.9895	0.9895	0.9896	0.9896	0.9897	26.00
26.25	0.9889	0.9890	0.9890	0.9891	0.9891	0.9892	0.9892	0.9893	0.9893	0.9894	0.9894	26.25
26.50	0.9886	0.9887	0.9888	0.9888	0.9889	0.9889	0.9890	0.9890	0.9891	0.9892	0.9892	26.50
26.75	0.9884	0.9885	0.9885	0.9886	0.9886	0.9887	0.9887	0.9888	0.9889	0.9889	0.9890	26.75
27.00	0.9882	0.9882	0.9883	0.9883	0.9884	0.9884	0.9885	0.9886	0.9886	0.9887	0.9887	27.00
27.25	0.9879	0.9880	0.9880	0.9881	0.9881	0.9882	0.9883	0.9883	0.9884	0.9884	0.9885	27.25
27.50	0.9877	0.9877	0.9878	0.9878	0.9879	0.9880	0.9880	0.9881	0.9881	0.9882	0.9883	27.50
27.75	0.9874	0.9875	0.9875	0.9876	0.9877	0.9877	0.9878	0.9878	0.9879	0.9880	0.9880	27.75
28.00	0.9872	0.9872	0.9873	0.9874	0.9874	0.9875	0.9875	0.9876	0.9877	0.9877	0.9878	28.00
28.25	0.9869	0.9870	0.9870	0.9871	0.9872	0.9872	0.9873	0.9874	0.9874	0.9875	0.9876	28.25
28.50	0.9867	0.9867	0.9868	0.9869	0.9869	0.9870	0.9871	0.9871	0.9872	0.9873	0.9873	28.50
28.75	0.9864	0.9865	0.9866	0.9866	0.9867	0.9868	0.9868	0.9869	0.9870	0.9870	0.9871	28.75
29.00	0.9862	0.9862	0.9863	0.9864	0.9864	0.9865	0.9866	0.9867	0.9867	0.9868	0.9868	29.00
29.25	0.9859	0.9860	0.9861	0.9861	0.9862	0.9863	0.9863	0.9864	0.9865	0.9865	0.9866	29.25
29.50	0.9857	0.9857	0.9858	0.9859	0.9860	0.9860	0.9861	0.9862	0.9862	0.9863	0.9864	29.50
29.75	0.9854	0.9855	0.9856	0.9856	0.9857	0.9858	0.9859	0.9859	0.9860	0.9861	0.9861	29.75
30.00	0.9852	0.9853	0.9853	0.9854	0.9855	0.9856	0.9856	0.9857	0.9858	0.9858	0.9859	30.00
30.25	0.9849	0.9850	0.9851	0.9852	0.9852	0.9853	0.9854	0.9855	0.9855	0.9856	0.9857	30.25
30.50	0.9847	0.9848	0.9848	0.9849	0.9850	0.9851	0.9851	0.9852	0.9853	0.9854	0.9854	30.50
30.75	0.9844	0.9845	0.9846	0.9847	0.9847	0.9848	0.9849	0.9850	0.9851	0.9851	0.9852	30.75
31.00	0.9842	0.9843	0.9843	0.9844	0.9845	0.9846	0.9847	0.9847	0.9848	0.9849	0.9850	31.00
31.25	0.9839	0.9840	0.9841	0.9842	0.9843	0.9843	0.9844	0.9845	0.9846	0.9847	0.9847	31.25
31.50	0.9837	0.9838	0.9839	0.9839	0.9840	0.9841	0.9842	0.9843	0.9843	0.9844	0.9845	31.50
31.75	0.9834	0.9835	0.9836	0.9837	0.9838	0.9839	0.9839	0.9840	0.9841	0.9842	0.9843	31.75
32.00	0.9832	0.9833	0.9834	0.9834	0.9835	0.9836	0.9837	0.9838	0.9839	0.9839	0.9840	32.00
32.25	0.9829	0.9830	0.9831	0.9832	0.9833	0.9834	0.9835	0.9835	0.9836	0.9837	0.9838	32.25
32.50	0.9827	0.9828	0.9829	0.9830	0.9830	0.9831	0.9832	0.9833	0.9834	0.9835	0.9835	32.50

• DENOTES EXTRAPOLATED VALUE

DENSITY = 790.0 TO 810.0

TABLE 54A, GENERALIZED CRUDE OILS
VOLUME CORRECTION TO 15 C

TEMP. C	DENSITY AT 15 C: 790.0	792.0	794.0	796.0	798.0	800.0	802.0	804.0	806.0	808.0	810.0	TEMP. C
	FACTOR FOR CORRECTING VOLUME TO 15 C											
32.50	0.9827	0.9828	0.9829	0.9830	0.9830	0.9831	0.9832	0.9833	0.9834	0.9835	0.9835	32.50
32.75	0.9824	0.9825	0.9826	0.9827	0.9828	0.9829	0.9830	0.9831	0.9831	0.9832	0.9833	32.75
33.00	0.9822	0.9823	0.9824	0.9825	0.9826	0.9826	0.9827	0.9828	0.9829	0.9830	0.9831	33.00
33.25	0.9820	0.9820	0.9821	0.9822	0.9823	0.9824	0.9825	0.9826	0.9827	0.9828	0.9828	33.25
33.50	0.9817	0.9818	0.9819	0.9820	0.9821	0.9822	0.9822	0.9823	0.9824	0.9825	0.9826	33.50
33.75	0.9815	0.9816	0.9816	0.9817	0.9818	0.9819	0.9820	0.9821	0.9822	0.9823	0.9824	33.75
34.00	0.9812	0.9813	0.9814	0.9815	0.9816	0.9817	0.9818	0.9819	0.9820	0.9820	0.9821	34.00
34.25	0.9810	0.9811	0.9812	0.9812	0.9813	0.9814	0.9815	0.9816	0.9817	0.9818	0.9819	34.25
34.50	0.9807	0.9808	0.9809	0.9810	0.9811	0.9812	0.9813	0.9814	0.9815	0.9816	0.9817	34.50
34.75	0.9805	0.9806	0.9807	0.9808	0.9809	0.9810	0.9810	0.9811	0.9812	0.9813	0.9814	34.75
35.00	0.9802	0.9803	0.9804	0.9805	0.9806	0.9807	0.9808	0.9809	0.9810	0.9811	0.9812	35.00
35.25	0.9800	0.9801	0.9802	0.9803	0.9804	0.9805	0.9806	0.9807	0.9808	0.9809	0.9809	35.25
35.50	0.9797	0.9798	0.9799	0.9800	0.9801	0.9802	0.9803	0.9804	0.9805	0.9806	0.9807	35.50
35.75	0.9795	0.9796	0.9797	0.9798	0.9799	0.9800	0.9801	0.9802	0.9803	0.9804	0.9805	35.75
36.00	0.9792	0.9793	0.9794	0.9795	0.9796	0.9797	0.9798	0.9799	0.9800	0.9801	0.9802	36.00
36.25	0.9790	0.9791	0.9792	0.9793	0.9794	0.9795	0.9796	0.9797	0.9798	0.9799	0.9800	36.25
36.50	0.9787	0.9788	0.9789	0.9790	0.9791	0.9793	0.9794	0.9795	0.9796	0.9797	0.9798	36.50
36.75	0.9785	0.9786	0.9787	0.9788	0.9789	0.9790	0.9791	0.9792	0.9793	0.9794	0.9795	36.75
37.00	0.9782	0.9783	0.9784	0.9786	0.9787	0.9788	0.9789	0.9790	0.9791	0.9792	0.9793	37.00
37.25	0.9780	0.9781	0.9782	0.9783	0.9784	0.9785	0.9786	0.9787	0.9788	0.9790	0.9791	37.25
37.50	0.9777	0.9778	0.9779	0.9781	0.9782	0.9783	0.9784	0.9785	0.9786	0.9787	0.9788	37.50
37.75	0.9775	0.9776	0.9777	0.9778	0.9779	0.9780	0.9781	0.9783	0.9784	0.9785	0.9786	37.75
38.00	0.9772	0.9773	0.9775	0.9776	0.9777	0.9778	0.9779	0.9780	0.9781	0.9782	0.9783	38.00
38.25	0.9770	0.9771	0.9772	0.9773	0.9774	0.9776	0.9777	0.9778	0.9779	0.9780	0.9781	38.25
38.50	0.9767	0.9768	0.9770	0.9771	0.9772	0.9773	0.9774	0.9775	0.9776	0.9778	0.9779	38.50
38.75	0.9765	0.9766	0.9767	0.9768	0.9770	0.9771	0.9772	0.9773	0.9774	0.9775	0.9776	38.75
39.00	0.9762	0.9764	0.9765	0.9766	0.9767	0.9768	0.9769	0.9771	0.9772	0.9773	0.9774	39.00
39.25	0.9760	0.9761	0.9762	0.9763	0.9765	0.9766	0.9767	0.9768	0.9769	0.9770	0.9772	39.25
39.50	0.9757	0.9759	0.9760	0.9761	0.9762	0.9763	0.9765	0.9766	0.9767	0.9768	0.9769	39.50
39.75	0.9755	0.9756	0.9757	0.9759	0.9760	0.9761	0.9762	0.9763	0.9765	0.9766	0.9767	39.75
40.00	0.9752	0.9754	0.9755	0.9756	0.9757	0.9759	0.9760	0.9761	0.9762	0.9763	0.9764	40.00

* DENOTES EXTRAPOLATED VALUE

DENSITY = 790.0 TO 810.0

KILOGRAMS PER CUBIC METRE AND CUBIC METRES PER METRIC TON (TONNE)

DENSITY (15 DEGC)	KILOGRAMS PER CUBIC MTR	CUBIC MTRS PER TONNE	DENSITY (15 DEGC)	KILOGRAMS PER CUBIC MTR	CUBIC MTRS PER TONNE	DENSITY (15 DEGC)	KILOGRAMS PER CUBIC MTR	CUBIC MTRS PER TONNE
650	********	********	680	678.9	1.4730	710	708.9	1.4107
651	********	********	681	679.9	1.4708	711	709.9	1.4087
652	********	********	682	680.9	1.4687	712	710.9	1.4067
653	********	********	683	681.9	1.4665	713	711.9	1.4047
654	652.9	1.5317	684	682.9	1.4644	714	712.9	1.4027
655	653.9	1.5293	685	683.9	1.4622	715	713.9	1.4008
656	654.9	1.5270	686	684.9	1.4601	716	714.9	1.3988
657	655.9	1.5247	687	685.9	1.4580	717	715.9	1.3969
658	656.9	1.5224	688	686.9	1.4559	718	716.9	1.3949
659	657.9	1.5200	689	687.9	1.4537	719	717.9	1.3930
660	658.9	1.5177	690	688.9	1.4516	720	718.9	1.3910
661	659.9	1.5154	691	689.9	1.4495	721	719.9	1.3891
662	660.9	1.5131	692	690.9	1.4474	722	720.9	1.3872
663	661.9	1.5108	693	691.9	1.4453	723	721.9	1.3853
664	662.9	1.5086	694	692.9	1.4432	724	722.9	1.3833
665	663.9	1.5063	695	693.9	1.4412	725	723.9	1.3814
666	664.9	1.5040	696	694.9	1.4391	726	724.9	1.3795
667	665.9	1.5018	697	695.9	1.4370	727	725.9	1.3776
668	666.9	1.4995	698	696.9	1.4350	728	726.9	1.3757
669	667.9	1.4973	699	697.9	1.4329	729	727.9	1.3738
670	668.9	1.4950	700	698.9	1.4309	730	728.9	1.3719
671	669.9	1.4928	701	699.9	1.4288	731	729.9	1.3701
672	670.9	1.4906	702	700.9	1.4268	732	730.9	1.3682
673	671.9	1.4884	703	701.9	1.4247	733	731.9	1.3663
674	672.9	1.4861	704	702.9	1.4227	734	732.9	1.3645
675	673.9	1.4839	705	703.9	1.4207	735	733.9	1.3626
676	674.9	1.4817	706	704.9	1.4187	736	734.9	1.3607
677	675.9	1.4795	707	705.9	1.4167	737	735.9	1.3589
678	676.9	1.4774	708	706.9	1.4147	738	736.9	1.3571
679	677.9	1.4752	709	707.9	1.4127	739	737.9	1.3552
680	678.9	1.4730	710	708.9	1.4107	740	738.9	1.3534

650.000 TO 740.000 DENSITY (15 DEGC)

PAGE 1 OF TABLE 56

DENSITY (15 DEGC)	KILOGRAMS PER CUBIC MTR	CUBIC MTRS PER TONNE	DENSITY (15 DEGC)	KILOGRAMS PER CUBIC MTR	CUBIC MTRS PER TONNE	DENSITY (15 DEGC)	KILOGRAMS PER CUBIC MTR	CUBIC MTRS PER TONNE
740	738.9	1.3534	770	768.9	1.3006	800	798.9	1.2517
741	739.9	1.3515	771	769.9	1.2989	801	799.9	1.2502
742	740.9	1.3497	772	770.9	1.2972	802	800.9	1.2486
743	741.9	1.3479	773	771.9	1.2955	803	801.9	1.2470
744	742.9	1.3461	774	772.9	1.2938	804	802.9	1.2455
745	743.9	1.3443	775	773.9	1.2922	805	803.9	1.2439
746	744.9	1.3425	776	774.9	1.2905	806	804.9	1.2424
747	745.9	1.3407	777	775.9	1.2888	807	805.9	1.2408
748	746.9	1.3389	778	776.9	1.2872	808	806.9	1.2393
749	747.9	1.3371	779	777.9	1.2855	809	807.9	1.2378
750	748.9	1.3353	780	778.9	1.2839	810	808.9	1.2362
751	749.9	1.3335	781	779.9	1.2822	811	809.9	1.2347
752	750.9	1.3317	782	780.9	1.2806	812	810.9	1.2332
753	751.9	1.3300	783	781.9	1.2789	813	811.9	1.2317
754	752.9	1.3282	784	782.9	1.2773	814	812.9	1.2302
755	753.9	1.3264	785	783.9	1.2757	815	813.9	1.2286
756	754.9	1.3247	786	784.9	1.2741	816	814.9	1.2271
757	755.9	1.3229	787	785.9	1.2724	817	815.9	1.2256
758	756.9	1.3212	788	786.9	1.2708	818	816.9	1.2241
759	757.9	1.3194	789	787.9	1.2692	819	817.9	1.2226
760	758.9	1.3177	790	788.9	1.2676	820	818.9	1.2211
761	759.9	1.3160	791	789.9	1.2660	821	819.9	1.2197
762	760.9	1.3142	792	790.9	1.2644	822	820.9	1.2182
763	761.9	1.3125	793	791.9	1.2628	823	821.9	1.2167
764	762.9	1.3108	794	792.9	1.2612	824	822.9	1.2152
765	763.9	1.3091	795	793.9	1.2596	825	823.9	1.2137
766	764.9	1.3074	796	794.9	1.2580	826	824.9	1.2123
767	765.9	1.3057	797	795.9	1.2564	827	825.9	1.2108
768	766.9	1.3040	798	796.9	1.2549	828	826.9	1.2093
769	767.9	1.3023	799	797.9	1.2533	829	827.9	1.2079
770	768.9	1.3006	800	798.9	1.2517	830	828.9	1.2064

740.000 TO 830.000 DENSITY (15 DEGC)

PAGE 2 OF TABLE 56

This Table gives the weight in air, in kilograms, of a cubic metre of oil at 15 °C and the volume, in cubic metres, occupied at 15 °C by one tonne of oil, both being for values of density at 15 °C.

When a weight in kilograms is calculated by multiplying the determined density by the volume, in cubic metres, at the same temperature, the result is a weight *in vacuo*, which must be corrected for the buoyancy of air. This correction has been incorporated into the values in this Table.

Appendix 5 – Example of a grain loading calculation

The "M/S"... (see Appendix 2) is to load a cargo of wheat in Montreal, Canada, for Hamburg in Germany, during the month of August.

At departure Montreal the ship has fuel, water and stores as follows:

Fuel oil	500 tonnes
Diesel oil	130 tonnes
Fresh water	200 tonnes
Stores etc.	200 tonnes

Stowage factor of wheat is 1.3 m^3/tonne.

If there is a part-filled hold it is to be No. 3 hold and the grain depth is to be 9.0 m, with VCG = 6 m.

At arrival Hamburg, assume the following:

Stores etc.	200 tonnes	VCG = 9.15 m
Fuel oil (W/T Eng. Room)	200 tonnes	density = 0.95 t/m^3
Diesel oil (D.B. No. 7)	80 tonnes	density = 0.9 t/m^3
Fresh water (After Peak)	100 tonnes	

The VCG of tanks is as given in the tank capacity table.

The following Upsetting Moments for Holds are taken from the ship's "Grain Stability Information":

Hold No. 1	Full:	250 m^4
Hold No. 2	Full:	293 m^4
Hold No. 3	Slack:	3710 m^4
Hold No. 4	Full:	293 m^4
Hold No. 5	Full:	293 m^4
Hold No. 6	Full:	293 m^4

The ship is required to perform a type 4 calculation (Full), and tables II, III, IV, V, VIIB and IX are to be filled in (see 'Instructions to Masters Loading Grain in Canada', overleaf).

a) How many tonnes of wheat are to be loaded?
b) Fill in the tables in the approved way.

Calculation of amount of grain to be loaded

Deadweight (summer)	=	16546 tonnes
Fuel, stores, etc.		−1030 tonnes
∴Available deadweight	=	15516 tonnes

Total volume of holds = 20852 m^3

Capacity of holds (20852/1.3)	=	16040 tonnes
Available deadweight	=	15516 tonnes
∴Reduce capacity of No. 3 hold by		524 tonnes

CALCULATION OF STABILITY
FOR A VESSEL LOADING BULK
GRAIN IN ACCORDANCE WITH
CANADIAN GRAIN REGULATIONS

Department of Transport
Canadian Coast Guard
Ship Safety Branch

Captain:

You are required to complete a stability calculation prior to the commencement of loading. This is to indicate your vessel's worst condition during the forthcoming voyage. The calculation should be made on this form and presented to the Port Warden before the vessel can be issued with a Certificate of Readiness to Load. If there are any subsequent changes to the original stowage plan, (tonnages, commodities or stowage factors), you should prepare a corrected plan for the Port Warden's approval.

The manner in which this calculation is made will depend upon

(a) Your type of vessel

(b) The geographical position of your loading port, and

(c) The type of grain stability information with which your vessel has been provided.

TYPE 1 CALCULATION (5° ANGLE OF HEEL)

If your vessel is a bulk carrier and an "existing ship" under the provisions of IMCO Resolution A264 (VIII) Part B, Sec. V(B), you are required to prove that your vessel's angle of heel, if grain shifts, will not exceed 5°. Your stability information will indicate if your vessel is of this type and if so you should complete only Tables I, II, III, IV and VII A.

If your vessel has to meet the provisions of Regulation 4 of the above Resolution, i.e. Maximum Values of (a) Angle of Heel 12°, and Minimum Values of (b) Residual Stability 0.075 metre radians and (c) GM 0.30M, you should complete the form by one of the following methods.

TYPE 2 CALCULATION (ALLOWABLE *UPSETTING MOMENTS, 12° ANGLE OF HEEL)

If your vessel's grain stability information contains a table of Allowable Upsetting Moments complete only Tables I, II, III, IV.V and VI.

TYPE 3 CALCULATION (WITHOUT ALLOWABLE UPSETTING MOMENTS, 12° ANGLE OF HEEL) ABBR.

If you are not provided with a table of Allowable Upsetting Moments complete only Tables I, II, III, IV, V, VIIB and VIII.

If however the GZ curve depicted in your grain stability information booklet that is closest to your proposed loading condition is not of a normal configuration, or the maximum GZ value of such curve occurs before 40°, then you should complete:

TYPE 4 CALCULATION (WITHOUT ALLOWABLE UPSETTING MOMENTS, 12° ANGLE OF HEEL) FULL

In this case complete Tables I, II, III, IV, V, VIIB and IX.

TYPE 5 CALCULATION (5° ANGLE OF HEEL) TANKERS

If your vessel is a tanker all tanks except two (two wings or two centres) must be trimmed full or you will be required to meet the conditions described in TYPE I above (5° ANGLE OF HEEL).

Your Administration may have provided you with a statement stating that your vessel at all times meets the required conditions for draft and initial GM values and in this case no calculation is necessary. Alternatively you may have information enabling you to complete a TYPE I Calculation. If not you should complete only Tables I, II, III, and VIIC.

* It is possible that the term "heeling moment" is used in some stability booklets. This term is an alternative for "upsetting moment" and the two are to be taken to mean the same.

TYPE 6 CALCULATION (REDUCED STABILITY CRITERIA, SHELTERED WATERS)

If your vessel is loading at more than one port within sheltered waters you may not be able to meet fully the requirements laid down in your stability documents whilst in transit between such ports. In this instance you may take advantage of a relaxation of such requirements whilst in transit between ports. In this case you should complete Tables I, II, III and X.

If you meet the requirements of Table X your vessel will not in fact list more than 15° if grain in all slack holds shifts through an angle with the horizontal of 12°, nor will your available freeboard be immersed by more than 50%. Before taking advantage of this provision you are advised to study Section 11 of the Canadian Grain Regulations.

If it is decided to take advantage of this relaxation, it should be borne in mind that your vessel will have to comply fully with the Regulations prior to departure from sheltered waters.

OTHER CONDITIONS

Vessels having onboard documents requiring other than the criteria described above, or no documents, should consult with the Port Warden for further instructions.

Transport Canada Transports Canada

TABLE 1

CALCULATION OF STABILITY FOR VESSELS LOADING BULK GRAIN

GENERAL PARTICULARS

NAME OF VESSEL ☐ S.S. ☑ M.V.	PORT OF REGISTRY
TYPE OF VESSEL ☑ BULK CARRIER ☐ TWEEN DECKER ☐ TANKER ☐ OTHER (Indicate Type)	OFFICIAL NUMBER
	CALL SIGN
APPROPRIATE LOADLINE ☑ S ☐ W ☐ WNA	DRAFT 8.98 m
	FREEBOARD 3.54 m

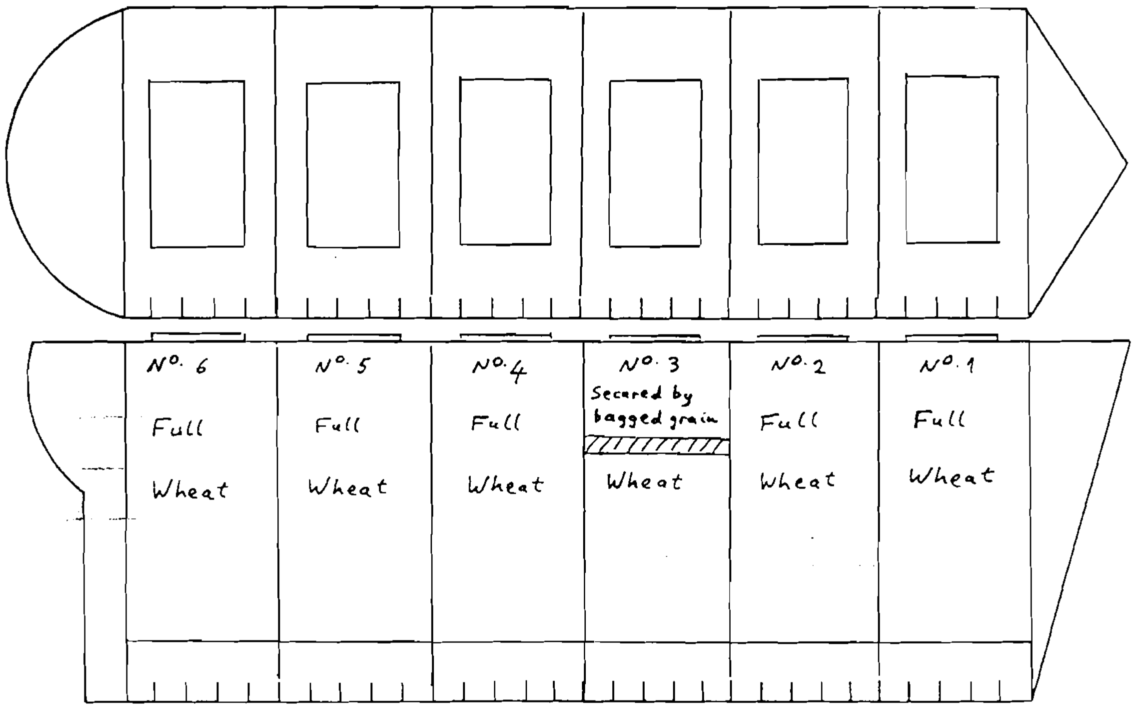
DEADWEIGHT 16546 ~~Tons~~ /Tonnes | F.W.A. 19 ~~INS~~/CMS | T.P. CM. ~~T.P.I.~~ 27.7

LOADING PORT(S) MONTREAL

DISCHARGING PORT(S) HAMBURG

GRAIN STABILITY INFORMATION, APPROVAL AUTHORITY AND DATE

CARGO PLAN: INDICATE HOLDS, TWEEN DECKS, COAMINGS/TRUNKS, TYPE OF GRAIN, SECURED AND UNSECURED SURFACES AND BALLAST.



DEPARTURE CONDITION				TYPE OF STABILITY CALCULATION
CREW & STORES (CONSTANT)	200	BALLAST	NIL	TYPE 1, 2, 3, 4, 5, 6 OR OTHER (Indicate Type)
BUNKERS	630	CARGO	15516	Type 4
FRESH WATER	200	TOTAL DEADWEIGHT	16546 Tons /Tonnes	

I CERTIFY THAT THE CALCULATIONS SHOWN ON THIS DOCUMENT INDICATE THE WORST STABILITY CONDITION THAT WILL BE EXPERIENCED DURING THE VOYAGE.

17 Aug 1990	MONTREAL	
DATE	PORT	MASTER

TABLE II

CALCULATION OF KG

FOR FULL COMPARTMENTS INDICATE WHETHER CARGO CENTRES "C" OR VOLUMETRIC CENTRES "V" ARE USED. IF YOUR GRAIN STABILITY INFORMATION DOES NOT DESCRIBE WHICH ARE USED PRESUME "V" VALUES USED.

COMPARTMENT NUMBER	GRAIN CUBIC CU. ~~FT.~~/M.	WEIGHT ~~TONS~~/ TONNES	KG ~~FT~~/M	SOLID MOMENTS = WEIGHT X KG	"C" OR "V" CENTRES
LIGHT SHIP		4895	7.8	38181	
CREW & STORES		200	9.15	1830	
CARGO					
Hold No. 1	2919	2245.4	7.83	17581.5	V
Hold No. 2	3577	2751.5	7.14	19645.7	V
Hold No. 3	2926	2250.6	6.0	13503.6	C
Hold No. 4	3607	2774.6	7.13	19782.9	V
Hold No. 5	3603	2771.5	7.13	19760.8	V
Hold No. 6	3539	2722.3	7.19	19573.3	V
SUBTOTAL (1) ▶		20611	SUBTOTAL (2) ▶	149859	

LIQUIDS' WORST CONDITION

TANK NUMBER	WEIGHT ~~TONS~~/ TONNES	KG ~~FT~~/M	LIQUID MOMENTS = WEIGHT X KG	FREE SURFACE MOMENTS
W/t. Eng. Room	200	4.88	976	(120 × 0.95) = 114
Db. No. 7	80	1.34	107.2	(81 × 0.9) = 73
Afterpeak	100	7.98	798	(206 × 1) = 206
SUB-TOTAL SUB-TOTAL (1)	380 + 20611	SUB TOTAL SUB-TOTAL (2)	1881 + 149859	TOTAL F.S. MOMENTS ▶ 393
DISPLACEMENT	20991	TOTAL MOMENTS	151740	

TABLE III

CALCULATION OF KG & GM

UNCORRECTED KG FROM:	TOTAL MOMENTS (TABLE II) / DISPLACEMENT (TABLE II)	=	151 740 / 20991	7.229 ~~ft~~/M
LIQUID F.S. GAIN FROM:	TOTAL F.S. MOMENTS (TABLE II) / DISPLACEMENT (TABLE II)	=	393 / 20991	+ 0.019
CORRECTED KG		=		– 7.248
KM (FROM SHIP'S STABILITY INFORMATION) FOR DISPLACEMENT SHOWN IN TABLE II				+ 8.45
∴ LEAST GM = 1.2	~~ft~~/M (MUST NOT BE LESS THAN 12 inches/0.3M.)			1.20

TABLE IV UPSETTING MOMENTS

COMPARTMENT NUMBER	GRAIN DEPTH ~~ft~~/M ~~OR ULLAGE~~	STOWAGE FACTOR ~~CU. FT.~~ CU. M. PER ~~TON~~ TONNE	VOLUMETRIC UPSETTING MOMENT ~~ft⁴~~ / M⁴	UPSETTING MOMENT ~~FT. TONS~~/ M. TONNES
Hold No. 1	Full	1.3	250	192.3
Hold No. 2	Full	1.3	293	225.4
Hold No. 3	9.0	1.3	3710	2853.8
Hold No. 4	Full	1.3	293	225.4
Hold No. 5	Full	1.3	293	225.4
Hold No. 6	Full	1.3	293	225.4
USE THIS TOTAL FOR TABLE VIIA, AND FOR TABLE VIIB ONLY WHEN THE 12% CORRECTION FOR THE VERTICAL SHIFT OF G IN SLACK COMPARTMENTS IS INCORPORATED IN THE SHIPS DATA OTHERWISE COMPLETE TABLE V TO CALCULATE ANGLE OF HEEL IN TABLE VIIB.			TOTAL UPSETTING MOMENT	3947.7

TABLE V UPSETTING MOMENT CORRECTION FOR VERTICAL SHIFT OF G IF NOT INCLUDED IN SHIPS DATA

1. TOTAL UPSET MOMENTS FOR SLACK COMPARTMENT TABLE IV MULTIPLY

2853.8 x 1.12 = 3196.3

2. TOTAL UPSET MOMENTS FOR FULL COMPARTMENT (TABLE IV) = 1093.9

TOTAL CORRECTED VALUE OF UPSETTING MOMENTS = 4290.2

TABLE VI MAXIMUM ALLOWABLE UPSETTING MOMENTS

CORRECTED KG (FROM TABLE III)	
DISPLACEMENT (FROM TABLE II)	
(A) MAXIMUM ALLOWABLE UPSETTING MOMENT (FROM SHIP'S STABILITY BOOK)	
(B) ACTUAL CORRECTED VALUE OF UPSETTING MOMENTS FROM (TABLE V)	

IF (A) EXCEEDS (B) VESSEL COMPLIES

TABLE VIIA ANGLE OF HEEL CALCULATION (FOR 5° CRITERION)

NAT TAN ANGLE OF HEEL $= \dfrac{\text{SUM OF UPSETTING MOMENTS (TABLE IV)*}}{\text{DISPLACEMENT (TABLE II) X GM (TABLE III)}}$

*12% CORRECTION DOES NOT APPLY IN THIS CASE

= ______ X ______

∴ ANGLE OF HEEL =

IF ANGLE IS LESS THAN 5° VESSEL COMPLIES

TABLE VIIB ANGLE OF HEEL CALCULATION (FOR 12° CRITERION)

NAT TAN ANGLE OF HEEL $= \dfrac{\text{SUM OF UPSETTING MOMENTS (TABLE IV) OR (TABLE V)}}{\text{DISPLACEMENT (TABLE II) X GM (TABLE III)}}$

$= \dfrac{4290.2}{20991 \times 1.20} = 0.1703$

∴ ANGLE OF HEEL = 9°.7

IF ANGLE IS LESS THAN 12° VESSEL COMPLIES

TABLE VIIC ANGLE OF HEEL CALCULATION FOR TANKERS (5° CRITERION)

TOTAL COMBINED LENGTH OF ALL WING TANKS TO BE LOADED (L) (P. AND S. TANKS BOTH COUNTED) = FT. M.

MAXIMUM BREADTH OF WING TANKS TO BE LOADED (B) =

TOTAL COMBINED LENGTH OF ALL CENTRE TANKS TO BE LOADED (L_1) =

MAXIMUM BREADTH OF CENTRE TANKS TO BE LOADED (B_1) =

WING TANKS UPSETTING MOMENT

$= \dfrac{.0177LB^3}{S.F.} = \dfrac{.0177 \times (L) \quad X(B) \quad X(B) \quad X(B)}{(S.F.)} =$

CENTRE TANKS UPSETTING MOMENT

$= \dfrac{.0177L_1B_1^3}{S.F.} = \dfrac{.0177X(L_1) \quad X(B_1) \quad X(B_1) \quad X(B_1)}{(S.F.)} =$

TOTAL UPSETTING MOMENT ______ FT. TONS / M. TONNES

NAT TAN OF HEEL $= \dfrac{\text{TOTAL UPSETTING MOMENT}}{\text{DISPLACEMENT (TABLE II) X GM (TABLE III)}} =$

∴ ANGLE OF HEEL = ______ =

IF ANGLE OF HEEL LESS THAN 5° VESSEL COMPLIES

IF CARGOES HAVING DIFFERENT STOWAGE FACTORS ARE LOADED, SEPARATE CALCULATIONS ARE REQUIRED FOR EACH. USE SPACE UNDER TABLE VIII.

TABLE VIII **CORRECTED RIGHTING ARM AT 40° HEEL USING CROSS CURVES**

GZ FROM CROSS CURVES (SHIP'S STABILITY INFORMATION) = ______ FT/M

GZ OBTAINED USING KG VALUE OF ( ) FT/M

CORRECTION FOR KG DIFFERENCE =

GZ AT 40° HEEL OR GZ = KN – KG (SIN 40°) =

UPSETTING ARM CORRECTION = 0.8 X $\frac{\text{CORRECTED UPSETTING MOMENT}}{\text{DISPLACEMENT}}$ =

= $\frac{\textit{TABLE IV OR TABLE V}}{\textit{TABLE II}}$ X 0.8 = ______ X 0.8 = ______

CORRECTED GZ AT 40° HEEL =

MINIMUM REQUIRED GZ AT 40° HEEL 1.008 FT. / 0.307 M > =

EXCEEDS MINIMUM BY =

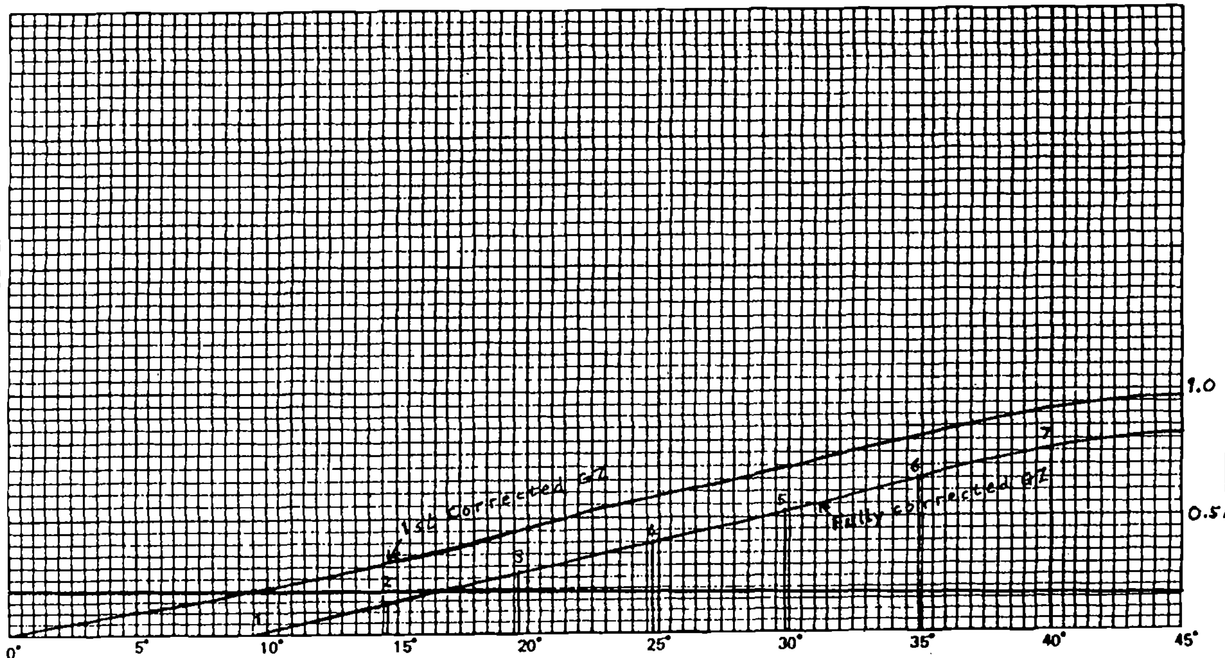
IF GZ CURVE IN THE NEAREST TYPICAL LOADED CONDITION SHOWN IN STABILITY BOOKLET IS OF NORMAL FORM AND MAXIMUM GZ OCCURS AT NOT LESS THAN 40° THEN VESSEL COMPLIES. IF NOT THEN TABLE IX MUST BE COMPLETED. IF VOLUMETRIC MOMENTS ARE CARRIED FROM TABLE V THEY MUST BE DIVIDED BY THE STOWAGE FACTOR BEFORE USE IN THIS TABLE.

SPACE FOR CALCULATIONS OR PROCOM INFORMATION AS REQUIRED.

θ	KN	$KG \times \sin\theta$	GZ
7°.5	1.1	0.95	0.15
15°	2.2	1.88	0.32
30°	4.3	3.62	0.68
45°	6.1	5.13	0.97
60°	7.2	6.28	0.92
75°	7.5	7.00	0.50

TABLE IX

TO DETERMINE RESIDUAL AREA BETWEEN THE UPSETTING ARM CURVE AND RIGHTING ARM CURVE



ANGLES OF HEEL (LIMITING ORDINATE FOR AREA IS 40°, ANGLE OF MAXIMUM GZ VALUE OR FLOODING ANGLE WHICHEVER IS LEAST)

SIMPSON'S PRODUCT FOR AREA			
	SELECTED ORDINATE	S.M	PRODUCT FOR AREA
No. 1	0	1	0
2	0.13	4	0.52
3	0.26	2	0.52
4	0.39	4	1.56
5	0.51	2	1.02
6	0.65	4	2.60
7	0.76	1	0.76
SUM OF PRODUCTS		▶	6.98

$\text{Interval} = \frac{40 - 9.7}{6} = 5°.05$

CORRECTION OF GZ VALUES									
ANGLES OF HEEL	5°	10°	15°	20°	25°	30°	35°	40°	45°
GZ VALUE FROM CROSS CURVES									
CORRECTIONS FOR DIFF. OF KG'S									
1st CORRECTED GZ VALUES (SEE NOTE III)	0.10	0.20	0.32	0.46	0.58	0.68	0.82	0.92	0.97
UPSETTING ARM ORDINATES (SEE NOTE II)	0.21	0.20	0.19	0.18	0.18	0.17	0.17	0.16	0.15
FULLY CORRECTED GZ VALUES	-0.11	0	0.13	0.28	0.40	0.51	0.65	0.76	0.82

AREA UNDER CURVE = $\frac{\text{SELECTED INTERVAL} \times \text{SUM OF PRODUCTS}}{3}$

$= \frac{5.05}{3} \times 6.98 = 11.74$ ~~FT. DEGREES~~ M. DEGREES

MINIMUM REQUIREMENT = 14,104 FT. DEGREES

4,298 M. DEGREES

NOTE I THE UPSETTING ARM CURVE IS A STRAIGHT LINE CONSTRUCTED BETWEEN THE FOLLOWING TWO VALUES:
AT 0° = GM (TABLE III) X TAN ANGLE OF HEEL $= 1.20 \times 0.1703 = 0.20$
AT 40° = GM (TABLE III) X TAN ANGLE OF HEEL X .8 $= 0.16$

NOTE II USE ORDINATES FROM UPSETTING ARM CURVE TO CORRECT GZ VALUES

NOTE III IF VESSEL IS PROVIDED WITH KN CURVES RATHER THAN GZ CURVES THE 1st CORRECTED Gz VALUES ARE OBTAINED BY:
GZ = KN − KG SIN θ°

TABLE X

ANGLE OF HEEL CALCULATION FOR VESSELS PROCEEDING BETWEEN PORTS IN SHELTERED WATERS

DIMENSIONS OF SLACK COMPARTMENT

		FT. M.		FT. M.
(a) NO.	MAXIMUM LENGTH (L)		MAXIMUM BREADTH (B)	
(b) NO.	MAXIMUM LENGTH (L)		MAXIMUM BREADTH (B)	
(c) NO.	MAXIMUM LENGTH (L)		MAXIMUM BREADTH (B)	

UPSETTING MOMENT OF SLACK COMPARTMENT

$= \dfrac{.0177LB^3}{\text{STOWAGE FACTOR}}$ (WHEN L = LENGTH OF THAT PORTION OF COMPARTMENT WITH NO CENTRELINE DIVISION

$+ \dfrac{.0044LB^3}{\text{STOWAGE FACTOR}}$ WHEN L = LENGTH OF THAT PORTION OF COMPARTMENT WITH CENTRELINE DIVISION

COMPARTMENT (a) $\dfrac{.0177 \text{ X (L)} \quad \text{X(B)} \quad \text{X(B)} \quad \text{X(B)}}{\text{(STOWAGE FACTOR)}} =$ FT. TONS / M. TONNES

COMPARTMENT (a) $\dfrac{.0044 \text{ X (L)} \quad \text{X(B)} \quad \text{X(B)} \quad \text{X(B)}}{\text{(STOWAGE FACTOR)}} =$

COMPARTMENT (b) $\dfrac{.0177 \text{ X (L)} \quad \text{X(B)} \quad \text{X(B)} \quad \text{X(B)}}{\text{(STOWAGE FACTOR)}} =$

COMPARTMENT (b) $\dfrac{.0044 \text{ X (L)} \quad \text{X(B)} \quad \text{X(B)} \quad \text{X(B)}}{\text{(STOWAGE FACTOR)}} =$

COMPARTMENT (c) $\dfrac{.0177 \text{ X (L)} \quad \text{X(B)} \quad \text{X(B)} \quad \text{X(B)}}{\text{(STOWAGE FACTOR)}} =$

COMPARTMENT (c) $\dfrac{.0044 \text{ X (L)} \quad \text{X(B)} \quad \text{X(B)} \quad \text{X(B)}}{\text{(STOWAGE FACTOR)}} =$

TOTAL UPSETTING MOMENT ________

$GM_1 = \dfrac{\text{TOTAL UPSETTING MOMENT X 3.73}}{\text{DISPLACEMENT (FROM TABLE II)}} = \dfrac{\text{X 3.73}}{\quad} =$ ____ FT / M

$GM_2 \quad \dfrac{\text{TOTAL UPSETTING MOMENT X BEAM}}{\text{DISPLACEMENT (FROM TABLE II) X FREEBOARD}} = \qquad =$ ____ FT / M

IF GM FOUND BY TABLE III EXCEEDS BOTH GM_1 AND GM_2, VESSEL COMPLIES FOR VOYAGE BETWEEN PORTS IN SHELTERED WATERS ONLY

Appendix 6 – Extract from the IMO Draft Handbook on Implementing International Maritime Safety Conventions through National Legislation

IMO Instruments

One of the primary objectives of the International Maritime Organization is "to provide machinery for co-operation among Governments in the field of governmental regulation and practices affecting shipping engaged in international trade" by, inter alia, providing for "the drafting of conventions, agreements, or other suitable instruments." In discharging this mandate, IMO has developed a large body of international instruments covering all aspects of shipping and related maritime activities. These agreements may be grouped into two main categories.

Conventions and other treaty instruments

The most significant instrument is the international convention or other treaty instrument. The Committees and subsidiary bodies of the IMO act as forums for drafting conventions on technical and legal matters relating to safety of navigation and protection of the marine environment. The draft conventions are submitted to diplomatic conferences which adopt the final text of the convention and determine the conditions for its entry into force, i.e. the number of States which must signify their consent to be bound and, in some cases, the share of the tonnage of the relevant shipping which must be registered in all the States bound by the convention or in any one of them. Consent to be bound by a convention is signified by ratification, acceptance, or approval or by accession. The effect of all these acts is the same, except that States which did not sign the text of the convention can only accede to it. When a sufficient number of States have signified their consent to be bound, the convention can come into force according to its terms. In addition to conventions, IMO adopts other treaty instruments such as Protocols and Agreements. The legal status and implications of all such instruments are the same as those of a convention.

An international convention is a treaty between two or more countries establishing certain principles or practices which they agree to apply in areas defined by the convention. The principles in a convention may be entirely new principles or they may be modifications of existing principles; or in some cases the conventions may merely codify or provide clarifications of generally accepted customary principles. Essentially, each State agrees to qualify the exercise of its sovereignty, in accordance with limits or conditions set by the terms of the convention. This is done by the parties undertaking, implicitly or explicitly, to implement the requirements of the convention and enforce them within their sphere of jurisdiction. This means that they will take appropriate and necessary steps to make the provisions of the convention part of their national legal regime.

International conventionmay address matters of public law or private law questions. Public law conventions ssentially deal with matters involving the relationship between States and public bodie Private law treaties, on the other hand, establish rules and regulations concerning rights and obligations between persons or entities in their private capacities. In so cases, a convention will have both public and private substantive aspects; ain all cases, a convention will have public law elements and implications since it is agreement between sovereign States.

A convention may haveeral distinct parts. The formal articles of the convention may deal with such matters e applicability of the convention in terms of geographical scope and the class of ons or property to which the convention applies, the obligations to be under by the parties, the requirements for bringing the convention into force, and the proc for amending the convention provisions. Most of IMO's technical conventions e annexes which contain the detailed technical regulations and procedures constithe real objectives of the convention. In some cases, these technical regulations nsupplemented by appendices or "protocols" dealing with specific matters which more detailed elaboration.

A convention may proit some part thereof is optional. This means that a State may become a party to thetion but may decide to exclude that part from the obligations it undertakes under thntion. This may be done by declaring that the part of the convention is not inclune expression of the consent to be bound or by a reservation with respet part of the provision. However, such partial acceptance or reservations can only provisions in respect of which the power to do so is available to States, eite convention itself or under the general international law of treaties.

Some conventions are brought up to date by means of a protocol. Changes may be made in a convention, subsequent to its entry into force, by means of protocols or through amendments adopted in accordance with the procedure specified in the convention. (In some cases it may be necessary to revise a convention even before it has entered into force, for example, in order to make it more acceptable to a greater number of States. This practice is highly discouraged by IMO (in Assembly resolution A.500(XII)). However, where the need is compelling, such revision may be made by means of a "Protocol Relating to" the convention.

In the case of conventions containing technical annexes, it is often necessary to provide for a flexible and expeditious method of amendment to enable the regulations to keep up with developments in the industry and other advances. In such cases, the convention will provide for a procedure of amendment which is based on the tacit acceptance procedure. This means that the proposals for changes are considered in the relevant Committees of IMO and adopted by the States parties. The adopted changes are then submitted to the parties for consideration, with a determination that the amendments will be deemed to have been accepted by the parties unless, by a specified date, a certain number of parties have indicated their objection to the amendments. Thereafter, the amendments enter into force on a date stipulated by the adopting Committee at the time the amendments are adopted. This means that the silence of any party to the convention is treated as an indication of its consent to the amendment.

This procedure is, however, only used to amend purely technical provisions. The formal treaty articles are usually amended by the traditional method which requires that amendments will enter into force after they have been formally accepted by a specified number (usually two thirds) of the States parties. This latter method is not used in respect of technical provisions because it has been found that it is not appropriate, since it entails long delays in bringing into force changes which are considered to be necessary and urgent.

Of the conventions and treaty instruments developed under the auspices of IMO since it commenced operation in 1959, thirty-four are now viable internationally. A number of others have been superseded, wholly or partially. Of the thirty-four instruments, however, twenty-four will be in force as at 26 October 1990. These, and the instruments not in force, remain under constant review by the relevant bodies of IMO and amendments or revisions are considered and adopted as and when necessary.

Recommendations and other 'non-treaty' instruments

The other form in which international regulations are adopted by IMO is the "non-treaty" instrument. This may have several different names, such as Codes, Recommendations, Guidelines, etc. This form is used when Governments conclude that a regulation, standard or practice, or suggestion for uniform policy or approach, may be adequate or appropriate to achieve the objective of improving safety at sea or the prevention of pollution, without necessarily being embodied in a formal treaty instrument. This may be because it is considered that the issues are not sufficiently clear to be formalized in treaty language; or there is not sufficient consensus in which to establish a clear rule which will be acceptable to a sufficient number of States as a mandatory rule. It may also be thought that the formality of a convention would be too complex to deal with a matter which may be more suitable for, or require, speedy action on a provisional basis, or the parties to a convention may believe that a provision needs clarification rather than formal amendment and that this could more or equally effectively be done by means of an "agreed or uniform interpretation" coupled with a recommendation that States implement the regulations or standards as thus interpreted.

Recommendations are generally made by the Assembly which, in the case of recommendations regarding maritime safety and the prevention of marine pollution from ships, is the organ with exclusive competence. However, in other matters the Committees, particularly the Maritime Safety Committee and the Marine Environment Protection Committee, may make recommendations - either on their own initiative or by way of power delegated to them by the Assembly.

Recommendations, unlike treaty provisions, are non-binding on States. They are recommended to States for implementation in whole or in part, according to their individual sovereign judgement. However, most of these recommendations carry significant weight because they are the outcome of intensive discussions among highly qualified experts and persons with considerable experience in the matters dealt with therein. In many cases, the recommendations supplement convention provisions and provide extremely useful guidelines on the most meaningful way to interpret and apply the provisions in an effective way. Such guidelines can, therefore, be of great assistance to national authorities who have to incorporate those provisions into national law and to devise procedures for their effective and practical implementation.

Where, for whatever reasons, it is considered that the non-treaty approach is preferable, the regulations or standards in question developed in the appropriate Committee of IMO are adopted by a formal resolution and communicated to Governments.

Where "recommendations" deal with technical issues in a major field of activity, such as the construction and equipment of particular types of ships, or the carriage of specific types of cargoes and dangerous goods, they are issued in the form of a Code. These are, however, of the same status as other "recommendations", except that they tend to be more widely known. In some cases, the Codes eventually become part of the treaty instruments to which they relate, either by being incorporated in the regulations of the treaty or by provisions which state that the requirements of the Code are included in the "obligations" undertaken by States parties.

In some cases, the regulations in an IMO Recommendation or Code may indeed be the only international rules and standards on the matter, and States cannot realistically disregard them if their maritime activities are to conform to internationally agreed standards.

Appendix 7 – Lloyd's Standard Form of Salvage Agreement

LOF 1990

EXPLANATORY NOTE

The Council of Lloyd's have approved a revised Lloyd's Standard Form of Salvage Agreement to be known as L.O.F. 1990 following recommendations received from the Lloyd's Form Working Party under the Chairmanship of the Lloyd's Appeal Arbitrator, Mr G.R.A. Darling, Q.C.

The following notes are to direct attention to the principal changes. It is necesary to refer to the full text for the terms and effects of these changes.

The format has been revised to set out in a more logical sequence the provisions of the Agreement. At the same time wherever possible the language has been simplified. It is hoped that the revised format will make the document more readily understandable particularly by those whose native language is not English.

The following revisions of substance have been made.

(a) The provisions of the International Convention on Salvage 1989 which apply to the relationship between salvors and the owners of salved property have been incorporated. The main consequence of that is to empower arbitrators to award special compensation in certain cases where the salved property threatened damage to the environment or while damage was prevented or minimised while the salvage operation was in progress. (See clauses 1(a) and 2.)

(b) With the prior agreement of the salvor security provided from sources outside the United Kingdom will be accepted by the Council of Lloyd's. (See clause 4(c)).

(c) In limited circumstances the owner of the ship is empowered to terminate the services. (See clause 18).

The Council have also approved Procedural Rules the aim of which is to ensure that at the outset the Arbitrator gives directions designed to lead to the most expeditious and cost effective conclusion having regard to the circumstances of a particular case (See clause 9(a)(ii)).

5.9.90

LOF 1990

LLOYD'S

NOTES

1. Insert name of person signing on behalf of Owners of property to be salved. The Master should sign wherever possible.

2. The Contractor's name should always be inserted in line 4 and whenever the Agreement is signed by the Master of the Salving vessel or other person on behalf of the Contractor the name of the Master or other person must also be inserted in line 4 before the words "for and on behalf of." The words "for and on behalf of" should be deleted where a Contractor signs personally.

3. Insert place if agreed in clause 1(a)(i) and currency if agreed in clause 1(e).

STANDARD FORM OF

SALVAGE AGREEMENT

(APPROVED AND PUBLISHED BY THE COUNCIL OF LLOYD'S)

NO CURE - NO PAY

On board the..

Dated.......................................

+ See Note 1 above

IT IS HEREBY AGREED between Captain+ .... for and on behalf of the Owners of the "..." her cargo freight bunkers stores and any other property thereon (hereinafter collectively called "the Owners") and...for and on behalf of..

** See Note 2 above*

....(hereinafter called "the Contractor"*) that:-

1. (a) The Contractor shall use his best endeavours:-

 # See Note 3 above

(i) to salve the"..."and/or her cargo freight bunkers stores and any other property thereon and take them to #..or to such other place as may hereafter be agreed either place to be deemed a place of safety or if no such place is named or agreed to a place of safety and

(ii) while performing the salvage services to prevent or minimize damage to the environment.

(b) Subject to clause 2 incorporating Convention Article 14 the services shall be rendered and accepted as salvage services upon the principle of "no cure - no pay."

(c) The Contractor's remuneration shall be fixed by Arbitration in London in the manner hereinafter prescribed and any other difference arising out of this Agreement or the operations thereunder shall be referred to Arbitration in the same way.

(d) In the event of the services referred to in this Agreement or any part of such services having been already rendered at the date of this Agreement by the Contractor to the said vessel and/or her cargo freight bunkers stores and any other property thereon the provisions of this Agreement shall apply to such services.

 # See Note 3 above

(e) The security to be provided to the Council of Lloyd's (hereinafter called "the Council") the Salved Value(s) the Award and/or any Interim Award(s) and/or any Award on Appeal shall be in #..currency.

(f) If clause 1(e) is not completed then the security to be provided and the Salved Value(s) the Award and/or Interim Award(s) and/or Award on Appeal shall be in Pounds Sterling.

15.1.08
3.12.24
13.10.26
12.4.50
10.6.53
20.12.67
23.2.72
21.5.80
5.9.90

(g) This Agreement and Arbitration thereunder shall except as otherwise expressly provided be governed by the law of England, including the English law of salvage.

PROVISIONS AS TO THE SERVICES

2. Articles 1(a) to (e), 8, 13.1, 13.2 first sentence, 13.3 and 14 of the International Convention on Salvage 1989 ("the Convention Articles") set out hereafter are hereby incorporated into this Agreement. The terms "Contractor" and "services" / "salvage services" in this Agreement shall have the same meanings as the terms "salvor(s)" and "salvage operation (s)" in the Convention Articles.

3. The Owners their Servants and Agents shall co-operate fully with the Contractor in and about the salvage including taining entry to the place named or the place of safety as defined in clause 1. The Contractor may make reasonablse of the vessel's machinery gear equipment anchors chains stores and other appurtenances during and for the puse of the salvage services free of expense but shall not unnecessarily damage abandon or sacrifice the same or aproperty the subject of this Agreement.

PROVISIONS AS TO SECURITY

4. (a) Contractor shall immediately after the termination of the services or sooner notify the Council and where practicable Owners of the amount for which he demands security (inclusive of costs expenses and interest) from each of spective Owners.

(b) e the exception to the principle of "no cure - no pay" under Convention Article 14 becomes likely to be applithe owners of the vessel shall on the demand of the Contractor provide security for the Contractor's special nsation.

(c) mount of any such security shall be reasonable in the light of the knowledge available to the Contractor at the tin the demand is made. Unless otherwise agreed such security shall be provided (i) to the Council (ii) in a forved by the Council and (iii) by persons firms or corporations either acceptable to the Contractor or residentnited Kingdom and acceptable to the Council. The Council shall not be responsible for the sufficiency (whethount or otherwise) of any security which shall be provided nor for the default or insolvency of any person corporation providing the same.

(d) ners of the vessel their Servants and Agents shall use their best endeavours to ensure that the cargo owners their proportion of security before the cargo is released.

5. (a) curity has been provided as aforesaid the Contractor shall have a maritime lien on the property salved for hisation. The property salved shall not without the consent in writing of the Contractor (which shall not be unry withheld) be removed from the place to which it has been taken by the Contractor under clause 1(a).

(b) ontractor shall not arrest or detain the property salved unless:-

security is not provided within 14 days (exclusive of Saturdays and Sundays or other days observed as general holidays at Lloyd's) after the date of the termination of the services or
he has reason to believe that the removal of the property salved is contemplated contrary to clause 5(a) or
any attempt is made to remove the property salved contrary to clause 5(a).

(c) rbitrator appointed under clause 6 or the Appeal Arbitrator(s) appointed under clause 11(d) shall have power inabsolute discretion to include in the amount awarded to the Contractor the whole or part of any expenses reasonacurred by the Contractor in:-

ascertaining demanding and obtaining the amount of security reasonably required in accordance with clause 4
(enforcing and/or protecting by insurance or otherwise or taking reasonable steps to enforce and/or protect his lien.

PROVISIONS AS TO ARBITRATION

6. (a) re security is provided to the Council in whole or in part the Council shall appoint an Arbitrator in respect of the proty covered by such security.

(b) ether security has been provided or not the Council shall appoint an Arbitrator upon receipt of a written request de by letter telex facsimile or in any other permanent form provided that any party requesting such appointmt shall if required by the Council undertake to pay the reasonable fees and expenses of the Council and/ or any Aitrator or Appeal Arbitrator(s).

(c) here an Arbitrator has been appointed and the parties do not proceed to arbitration the Council may recover any fees osts and/or expenses which are outstanding and thereupon terminate the appointment of such Arbitrator.

7. The Contractor's remuneration shall be fixed by the Arbitrator appointed under clause 6. Such remuneration shall not be diminished by reason of the exception to the principle of 'no cure - no pay' under Convention Article 14.

REPRESENTATION

8. Any party to this Agreement who wishes to be heard or to adduce evidence shall nominate a person in the United Kingdom to represent him failing which the Arbitrator or Appeal Arbitrator(s) may proceed as if such party had renounced his right to be heard or adduce evidence.

CONDUCT OF THE ARBITRATION

9. (a) The Arbitrator shall have power to :-

(i) admit such oral or documentary evidence or information as he may think fit
(ii) conduct the Arbitration in such manner in all respects as he may think fit subject to such procedural rules as the Council may approve
(iii) condemn the Contractor in his absolute discretion in the whole or part of the expense of providing excessive security and deduct the amount in which the Contractor is so condemned from the salvage remuneration and/or special compensation
(iv) make Interim Award(s) on such terms as may be fair and just
(v) make such orders as to costs fees and expenses including those of the Council charged under clauses 9(b) and 12(b) as may be fair and just.

(b) The Arbitrator and the Council may charge reasonable fees and expenses for their services whether the Arbitration proceeds to a hearing or not and all such fees and expenses shall be treated as part of the costs of the Arbitration.

(c) Any Award shall (subject to Appeal as provided in this Agreement) be final and binding on all the parties concerned whether they were represented at the Arbitration or not.

INTEREST

10. Interest at rates per annum to be fixed by the Arbitrator shall (subject to Appeal as provided in this Agreement) be payable on any sum awarded taking into account any sums already paid:-

(i) from the date of termination of the services unless the Arbitrator shall in his absolute discretion otherwise decide until the date of publication by the Council of the Award and/or Interim Award(s) and
(ii) from the expiration of 21 days (exclusive of Saturdays and Sundays or other days observed as general holidays at Lloyd's) after the date of publication by the Council of the Award and/or Interim Award(s) until the date payment is received by the Contractor or the Council both dates inclusive.

PROVISIONS AS TO APPEAL

11. (a) Notice of Appeal if any shall be given to the Council within 14 days (exclusive of Saturdays and Sundays or other days observed as general holidays at Lloyd's) after the date of the publication by the Council of the Award and/ or Interim Award(s).

(b) Notice of Cross-Appeal if any shall be given to the Council within 14 days (exclusive of Saturdays and Sundays or other days observed as general holidays at Lloyd's) after notification by the Council to the parties of any Notice of Appeal. Such notification if sent by post shall be deemed received on the working day following the day of posting.

(c) Notice of Appeal or Cross-Appeal shall be given to the Council by letter telex facsimile or in any other permanent form.

(d) Upon receipt of Notice of Appeal the Council shall refer the Appeal to the hearing and determination of the Appeal Arbitrator(s) selected by it.

(e) If any Notice of Appeal or Cross-Appeal is withdrawn the Appeal hearing shall nevertheless proceed in respect of such Notice of Appeal or Cross-Appeal as may remain.

(f) Any Award on Appeal shall be final and binding on all the parties to that Appeal Arbitration whether they were represented either at the Arbitration or at the Appeal Arbitration or not.

CONDUCT OF THE APPEAL

12. (a) The Appeal Arbitrator(s) in addition to the powers of the Arbitrator under clauses 9(a) and 10 shall have power to :-

- (i) admit the evidence which was before the Arbitrator together with the Arbitrator's notes and reasons for his Award and/or Interim Award(s) and any transcript of evidence and such additional evidence as he or they may think fit
- (ii) confirm increase or reduce the sum awarded by the Arbitrator and to make such order as to the payment of interest on such sum as he or they may think fit
- (iii) confirm revoke or vary any order and/or Declaratory Award made by the Arbitrator.

(b) The Appeal Arbitrator(s) and the Council may charge reasonable fees and expenses for their services in connection with the Appeal Arbitration whether it proceeds to a hearing or not and all such fees and expenses shall be treated as part of the costs of the Appeal Arbitration.

PROVISIONS AS TO PAYMENT

13. (a) In case of Arbitration if no Notice of Appeal be received by the Council in accordance with clause 11(a) the Council shall call upon the party or parties concerned to pay the amount awarded and in the event of non-payment shall subject to the Contractor first providing to the Council a satisfactory Undertaking to pay all the costs thereof realize or enforce the security and pay therefrom to the Contractor (whose receipt shall be a good discharge to it) the amount awarded to him together with interest if any. The Contractor shall reimburse the parties concerned to such extent as the Award is less than any sums paid on account or in respect of Interim Award(s).

(b) If Notice of Appeal be received by the Council in accordance with clause 11 it shall as soon as the Award on Appeal has been published by it call upon the party or parties concerned to pay the amount awarded and in the event of non-payment shall subject to the Contractor first providing to the Council a satisfactory Undertaking to pay all the costs thereof realize or enforce the security and pay therefrom to the Contractor (whose receipt shall be a good discharge to it) the amount awarded to him together with interest if any. The Contractor shall reimburse the parties concerned to such extent as the Award on Appeal is less than any sums paid on account or in respect of the Award or Interim Award(s).

(c) If any sum shall become payable to the Contractor as remuneration for his services and/or interest and/or costs as the result of an agreement made between the Contractor and the Owners or any of them the Council in the event of non-payment shall subject to the Contractor first providing to the Council a satisfactory Undertaking to pay all the costs thereof realize or enforce the security and pay therefrom to the Contractor (whose receipt shall be a good discharge to it) the said sum.

(d) If the Award and/or Interim Award(s) and/or Award on Appeal provides or provide that the costs of the Arbitration and/or of the Appeal Arbitration or any part of such costs shall be borne by the Contractor such costs may be deducted from the amount awarded or agreed before payment is made to the Contractor unless satisfactory security is provided by the Contractor for the payment of such costs.

(e) Without prejudice to the provisions of clause 4(c) the liability of the Council shall be limited in any event to the amount of security provided to it.

GENERAL PROVISIONS

14. The Master or other person signing this Agreement on behalf of the property to be salved enters into this Agreement as agent for the vessel her cargo freight bunkers stores and any other property thereon and the respective Owners thereof and binds each (but not the one for the other or himself personally) to the due performance thereof.

15. In considering what sums of money have been expended by the Contractor in rendering the services and/or in fixing the amount of the Award and/or Interim Award(s) and/or Award on Appeal the Arbitrator or Appeal Arbitrator(s) shall to such an extent and in so far as it may be fair and just in all the circumstances give effect to the consequences of any change or changes in the relevant rates of exchange which may have occurred between the date of termination of the services and the date on which the Award and/or Interim Award(s) and/or Award on Appeal is made.

16. Any Award notice authority order or other document signed by the Chairman of Lloyd's or any person authorised by the Council for the purpose shall be deemed to have been duly made or given by the Council and shall have the same force and effect in all respects as if it had been signed by every member of the Council.

17. The Contractor may claim salvage and enforce any Award or agreement made between the Contractor and the Owners against security provided under clause 4 if any in the name and on behalf of any Sub-Contractors Servants or Agents including Masters and members of the crews of vessels employed by him or by any Sub-Contractors in the services provided that he first provides a reasonably satisfactory indemnity to the Owners against all claims by or liabilities to the said persons.

18. When there is no longer any reasonable prospect of a useful result leading to a salvage reward in accordance with Convention Article 13 the owners of the vessel shall be entitled to terminate the services of the Contractor by giving notice to the Contractor in writing.

19. No person signing this Agreement or any party on whose behalf it is signed shall at any time or in any manner whatsoever offer provide make give or promise to provide demand or take any form of inducement for entering into this Agreement.

THE CONVENTION ARTICLES

Article 1

Definitions

(a) *Salvage operation* means any act or activity undertaken to assist a vessel or any other property in danger in navigable waters or in any other waters whatsoever

(b) *Vessel* means any ship or craft, or any structure capable of navigation

(c) *Property* means any property not permanently and intentionally attached to the shoreline and includes freight at risk

(d) *Damage to the environment* means substantial physical damage to human health or to marine life or resources in coastal or inland waters or areas adjacent thereto, caused by pollution, contamination, fire, explosion or similar major incidents

(e) *Payment* means any reward, remuneration or compensation due under this Convention

Article 8

Duties of the Salvor and of the Owner and Master

1. The salvor shall owe a duty to the owner of the vessel or other property in danger:

(a) to carry out the salvage operations with due care;

(b) in performing the duty specified in subparagraph (a), to exercise due care to prevent or minimize damage to the environment;

(c) whenever circumstances reasonably require, to seek assistance from other salvors; and

(d) to accept the intervention of other salvors when reasonably requested to do so by the owner or master of the vessel or other property in danger; provided however that the amount of his reward shall not be prejudiced should it be found that such a request was unreasonable

2. The owner and master of the vessel or the owner of other property in danger shall owe a duty to the salvor:

(a) to co-operate fully with him during the course of the salvage operations;

(b) in so doing, to exercise due care to prevent or minimize damage to the environment; and

(c) when the vessel or other property has been brought to a place of safety, to accept redelivery when reasonably requested by the salvor to do so

Article 13

Criteria for fixing the reward

1. The reward shall be fixed with a view to encouraging salvage operations, taking into account the following criteria without regard to the order in which they are presented below:

(a) the salved value of the vessel and other property;
(b) the skill and efforts of the salvors in preventing or minimizing damage to the environment;
(c) the measure of success obtained by the salvor;
(d) the nature and degree of the danger;
(e) the skill and efforts of the salvors in salving the vessel, other property and life;
(f) the time used and expenses and losses incurred by the salvors;
(g) the risk of liability and other risks run by the salvors or their equipment;

(h) the promptness of the services rendered;
(i) the availability and use of vessels or other equipment intended for salvage operations;
(j) the state of readiness and efficiency of the salvor's equipment and the value thereof

2. Payment of a reward fixed according to paragraph 1 shall be made by all of the vessel and other property interests in proportion to their respective salved values

3. The rewards, exclusive of any interest and recoverable legal costs that may be payable thereon, shall not exceed the salved value of the vessel and other property

Article 14

Special Compensation

1. If the salvor has carried out salvage operations in respect of a vessel which by itself or its cargo threatened damage to the environment and has failed to earn a reward under Article 13 at least equivalent to the special compensation assessable in accordance with this Article, he shall be entitled to special compensation from the owner of that vessel equivalent to his expenses as herein defined

2. If, in the circumstances set out in paragraph 1, the salvor by his salvage operations has prevented or minimized damage to the environment, the special compensation payable by the owner to the salvor under paragraph 1 may be increased up to a maximum of 30% of the expenses incurred by the salvor. However, the Tribunal, if it deems it fair and just to do so and bearing in mind the relevant criteria set out in Article 13, paragraph 1, may increase such special compensation further, but in no event shall the total increase be more than 100% of the expenses incurred by the salvor

3. Salvor's expenses for the purpose of paragraphs 1 and 2 means the out-of-pocket expenses reasonably incurred by the salvor in the salvage operation and a fair rate for equipment and personnel actually and reasonably used in the salvage operation, taking into consideration the criteria set out in Article 13, paragraph 1(h), (i) and(j)

4. The total special compensation under this Article shall be paid only if and to the extent that such compensation is greater than any reward recoverable by the salvor under Article 13

5. If the salvor has been negligent and has thereby failed to prevent or minimize damage to the environment, he may be deprived of the whole or part of any special compensation due under this Article

6. Nothing in this Article shall affect any right of recourse on the part of the owner of the vessel

For and on behalf of the Contractor	For and on behalf of the Owners of property to be salved.
.... (To be signed either by the Contractor personally or by the Master of the salving vessel or other person whose name is inserted in line 4 of this Agreement.)	.... (To be signed by the Master or other person whose name is inserted in line 1 of this Agreement.)

LLOYD'S

STANDARD FORM OF

SALVAGE AGREEMENT

PROCEDURAL RULES

made by the Council of Lloyd's

(pursuant to clause 9(a)(ii) of LOF 1990)

1. The Arbitrator appointed by Council under clause 6 of LOF 1990 shall within six weeks of his appointment or so soon thereafter as can reasonably be arranged hold a preliminary meeting unless a consent order shall have been agreed previously between the parties and approved by him.

2. With a view to ensuring that the arbitration proceeds as speedily and economically as possible, the Arbitrator shall at such preliminary meeting give all such directions as may be fair and just having particular but no exclusive regard to:-

(a) fixing dates for:-

(i) Proof of values
(ii) discovery
(iii) expert evidence
(iv) application(s) for interim awards
(v) the Arbitrator to monitor progress in the interlocutory stages of the arbitration
(vi) the hearing of the arbitration.

(b) (i) the interests of unrepresented parties and/or security
(ii) the form of the hearing in cases where shortened and/or simplified procedure may be appropriate
(iii) the reading of documentary evidence before the date appointed for the hearing of the arbitration
(iv) skeleton arguments or pleadings but only in special and appropriate circumstances

3. In case of non-compliance and/or late compliance with any such order the Arbitrator shall fix such terms as may be fair and just.

4. Nothing in the foregoing shall prevent any party from making application(s) for other preliminary meetings or restrict or curtail the existing powers of the Arbitrator.

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