

**MODEL
COURSE
7.04**

**OFFICER IN CHARGE
OF AN ENGINEERING
WATCH**

2014 EDITION

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ENGINEERING WATCH**

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Foreword

Since its inception the International Maritime Organization (IMO) has recognized the importance of human resources to the development of the maritime industry and has given the highest priority to assisting developing countries in enhancing their maritime training capabilities through the provision or improvement of maritime training facilities at national and regional levels. IMO has also responded to the needs of developing countries for postgraduate training for senior personnel in administrations, ports, shipping companies and maritime training institutes by establishing the World Maritime University in Malmö, Sweden, in 1983.

Following the adoption of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW), a number of IMO Member Governments had suggested that IMO should develop model training courses to assist in the implementation of the Convention and in achieving a more rapid transfer of information and skills regarding new developments in maritime technology. IMO training advisers and consultants also subsequently determined from their visits to training establishments in developing countries that the provision of model courses could help instructors improve the quality of their existing courses and enhance their implementation of the associated Conference and IMO Assembly resolutions.

In addition, it was appreciated that a comprehensive set of short model courses in various fields of maritime training would supplement the instruction provided by maritime academies and allow administrators and technical specialists already employed in maritime administrations, ports and shipping companies to improve their knowledge and skills in certain specialized fields. With the generous assistance of the Government of Norway, IMO developed model courses in response to these generally identified needs and now keeps them updated through a regular revision process taking into account any amendments to the requirements prescribed in IMO instruments and any technological developments in the field.

These model courses may be used by any training institution and, when the requisite financing is available, the Organization is prepared to assist developing countries in implementing any course.

K. SEKIMIZU
Secretary-General

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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.

Rather, this document should be used as a guide with the course duration given as indicative of the expected time required to cover the required outcomes. The parties may modify this course to suit their respective training schemes.

For those following planned training schemes approved by the administration, it is intended that this training may form an integral part of the overall training plan and be complementary to other studies. The training may be undertaken in progressive stages; for such candidates, it is not appropriate to specify the duration of the learning, provided achievement of the specified learning outcomes is properly assessed and recorded.

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 to recommendations.

This is the next 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 that 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 and may need to reallocate 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 has been 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 objective. 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
- workshops and 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 four functions at the operational level. On successful completion of the training and assessment trainees should be competent to carry out safely the watchkeeping duties of an officer in charge of an engineering watch in a manned engine-room or designated duty engineer in a periodically unmanned engine-room, both at sea and in port. In particular, they will be fully conversant with the basic principles to be observed in keeping an engineering watch as per STCW regulation VIII/2 and STCW Code, chapter VIII.

■ Entry standards

Since the minimum age for certification is 18 years, it is expected that in most cases the entry age will be at least 16 years. It is envisaged that trainees will have been in full-time education up to the commencement of training, although in some instances entry will no doubt be made available to those who, having completed full-time education, follow other paths first. Administrations will wish to specify their own educational standards for entry. With this in mind, attention is drawn to the fact that while the mathematical standards of the courses to be followed are not high, trainees continually use fundamental mathematics as a tool throughout the whole of their training; also, as the principles of applied science and engineering are included at an early stage, it is essential to ascertain the potential and interest in this kind of work before entry. In a similar manner, trainees have to accomplish a range of engineering craft skills, and therefore an aptitude and interest in this direction are also necessary.

Where entrants have not reached the required standards in mathematics or physical science it will be necessary to provide a preparatory course or courses to bring them to the desired level before starting the professional studies. Conversely, topics which have been adequately covered during their general education can be omitted and the allotted time reduced accordingly.

No previous maritime or engineering training is assumed, but those entering the course should be following an approved programme of shipboard training.

■ Course intake limitations

Training to acquire engineering skills in workshops will be planned and implemented for a certain period of time. During these periods it is recommended that there are not more than

approximately ten trainees to each supervisor/instructor. Depending upon staffing levels and how the timetable and utilization of premises can be arranged, other subjects may be studied in class sizes of 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.

■ Textbooks

A large number of books and publications may be used to study marine engineering. The framework in each function contains details of specified textbooks which are referred to in the syllabus by page number appropriate to the learning objectives. Other books may be considered equally suitable; the chosen books should help trainees to achieve the learning objectives.

Details of additional books which would provide useful library references and further background reading are included where appropriate in each subject.

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 asset to a maritime training establishment.

■ Training and the STCW Convention 1978, as amended

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 2010. This IMO model course has been revised and updated to cover the competences in STCW Code. It sets out the education and training to achieve those standards.

This course covers the minimum standard of competence for officers in charge of an engineering watch in a manned engine-room or designated duty engineers in a periodically unmanned engine-room, see STCW Code, table A-III/1.

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

- | | |
|------------|---|
| Function 1 | Marine engineering at the operational level |
| Function 2 | Electrical, electronic and control engineering at the operational level |
| Function 3 | Maintenance and repair at the operational level |
| Function 4 | Controlling the operation of the ship and care for the persons on board at the operational level. |

Each function is addressed in five parts: Part A which is common for all functions, Part B, Part C, Part D and Part E, which again addresses all the functions.

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 included which affects all four functions.

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.

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.

Part D gives the Instructor Manual, which contains guidance notes for the instructor and additional explanations.

Part E provides the Evaluation which addresses all the functions. A separate IMO model course 3.12 also 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. An excerpt of this model course is also included in Part E to aid the instructors.

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: qualifications of instructors, supervisors and 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 of officers in charge of an engineering watch specified in the minimum standard of competence tables of part A of the STCW Code have to be used in the assessment of all competences listed in those tables.

■ **Ships without steam boilers**

The function Marine Engineering at the Operational Level includes competences concerned with the operation of steam boilers. These are addressed in the detailed teaching syllabus in Part C. Candidates for certification for service on ships in which steam boilers do not form part of their machinery may omit the relevant requirements. Certificates so awarded should not be valid for service on ships in which steam boilers form part of their machinery until the engineer officer meets the standard of competence in the items previously omitted. Such limitations are required to be shown on the certificate and in the endorsement.

■ **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 III/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.

■ **Conventions, Regulations and Legislation**

These are constantly being revised and updated. It is essential that the up-to-date version of these are being used and that all references to particular versions in this model course should be taken to include all future amendments and revisions.

Part A: Course Framework for all functions

■ Aims

This model course aims to meet the mandatory minimum requirements for knowledge, understanding and proficiency in table A-III/1 of STCW Code for the functions Marine Engineering, Electrical, Electronic and Control Engineering, Maintenance and Repair and Controlling the Operation of the Ship and Care for Persons on Board at the Operational Level.

■ Objective

Function 1

This syllabus covers the requirements of the STCW Code, chapter III, section A-III/1. This functional element provides the detailed knowledge to support the training outcomes related to Marine Engineering at the Operational Level.

This section provides the background knowledge and practical work to support:

- maintaining a safe engineering watch
- using English in written and oral form
- using internal communication systems
- operating main and auxiliary machinery and associated control systems
- operating fuel, lubrication, ballast and other pumping systems and associated control systems.

Function 2

This syllabus covers the requirements of the STCW Code, chapter III, section A-III/1. This functional element provides the detailed knowledge to support the training outcomes related to Electrical, Electronic and Control Engineering at the Operational Level.

This section provides the background knowledge and practical work to support:

- the safety requirements for working on electrical tasks
- the ship's electrical engineering and electronics
- control engineering
- power distribution systems.

Function 3

This syllabus covers the requirements of the STCW Code, chapter III, section A-III/1. This functional element provides the detailed knowledge to support the training outcomes related to Maintenance and Repair at the Operational Level.

This section provides the background knowledge and practical work to support:

- the use of hand and machine tools and measuring instruments
- marine engineering maintenance.

Function 4

This syllabus covers the requirements of the Manila Amendment of STCW Code, chapter III, section A-III/1. 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 Operational Level.

This section provides the background knowledge to support:

- compliance with pollution prevention requirements
- maintaining the seaworthiness of the ship, including:
 - ship stability
 - ship construction
- prevention, control and fighting of fires on board ship*
- operation of life-saving appliances*
- provision of medical first aid on board ship*
- monitoring compliance with legislative requirements
- application of leadership and teamworking skills
- contributing to safety of personnel and ship.

This function includes topics such as ship stability, carriage of cargoes on deck, heavy lifts, containers, bulk cargoes, grain, dangerous goods, oil tankers and the IMO conventions.

■ Entry standards

This course is principally intended for candidates for certification as officers in charge of an engineering watch in a manned engine-room or designated duty engineers in a periodically unmanned engine-room. Those wishing to enter this course should be following an approved programme of on-board training.

■ 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-III/1 of STCW Code, for the functions Marine Engineering, Electrical, Electronic and Control Engineering, Maintenance and Repair and Controlling the Operation of the Ship and Care for Persons on Board at the Operational level. A certificate may be issued only by centres approved by the Administration.

* These topics are covered in separate IMO model courses.

■ 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. As well as instructors, additional staff will be required for the maintenance of machinery and equipment and for the preparation of materials, work areas and supplies for all practical work.

■ Teaching facilities and equipment

All functions

A classroom equipped with an overhead projector and a blackboard, whiteboard or flipchart should be provided for teaching the theory of the course and holding group discussions. The availability of appropriate engine room simulation equipment and/or replicated engines and engine-room equipment would be beneficial in developing the practical competence required by STCW Code.

Function 2

The following equipment is recommended for relevant laboratories:

- measuring/testing instruments (oscilloscope, voltmeters, ammeters, power meters, digital and analog multi meters, continuity testers, clamp meters, live-line testers, insulation testers, etc.)
- electrical circuit devices (various relays, switches, resistors, circuit breakers, fuses, lamps, transformers, connectors)
- examples of electrical diagrams (i.e. block, system, circuit and wiring diagrams)
- motors and several kinds of motor starters with starter circuits diagram
- model A.C. and D.C. generators
- a selection of marine cables, an earth lamp model system
- electronic circuit experiment equipment including electro circuit elements such as various semiconductor devices, thyristor, IGBT, MOSFET, LSI, LED), simple circuit diagrams and configurations
- various automatic control devices/equipment (PID controllers, sequencer, transducer, recorders, control valves, thermostats, pressure switches, level switches, iron-cored solenoid, resistance thermometer bulb, standard of adjustable resistance to create desired temperature signal, hydraulic testing equipment.
- PID control experiment equipment for temperature/level/pressure control system.

Function 3

A comprehensive workshop is required for the practical elements in the training objectives.