

**IALA World-Wide Academy**

**Model Course**

**For**

**Aids to Navigation**

**(Level 2 – Technician)**

**Surveying Range, Sector- Leading- lights and Floating marking**

**Edition 1.0**

**March 2013**

***AISM***Association Internationale de Signalisation Maritime ***IALA***

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DOCUMENT REVISIONS

Revisions to the IALA Document are to be noted in the table prior to the issue of a revised document.

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| **Date** | **Page / Section Revised** | **Requirement for Revision** |
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FOREWORD

The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) recognises that training in all aspects of Aids to Navigation (AtoN) service delivery, from inception through installation and maintenance to replacement or removal at the end of a planned life-cycle, is critical to the consistent provision of that AtoN service.

Taking into account that under the SOLAS Convention, Chapter 5, Regulation 13, paragraph 2; Contracting Governments, mindful of their obligations published by the International Maritime Organisation, undertake to consider the international recommendations and guidelines when establishing aids to navigation, including recommendations on training and qualification of AtoN technicians, IALA has adopted Recommendation E-141 on Standards for Training and Certification of AtoN personnel.

IALA Committees working closely with the IALA World Wide Academy have developed a series of model courses for AtoN personnel having E-141 Level 2 technician functions. This model course on rotating beacons and classical lenses should be read in conjunction with the Training Overview Document IALA WWA.L2.0 which contains standard guidance for the conduct of all Level 2 model courses

This model course is intended to provide national members and other appropriate authorities charged with the provision of AtoN services with specific guidance on the training of AtoN technicians in the installation and maintenance of rotating beacons and the alignment and focussing of lamps within classical lenses. Assistance in implementing this and other model courses may be obtained from the IALA World Wide Academy at the following address:

The Dean

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# PART A - COURSE OVERVIEW

## Scope

The purpose of this course is to provide participants with a basic understanding and overview of geodesy, satellite positioning and measuring accuracy and provide sufficient theoretical knowledge to carry out surveying of buoyage and light sectors with available ship systems.

## Objective

This course is intended to provide technicians with the theoretical and practical training necessary to know the factors affecting the sectors and position of floating marking.

Upon successful completion of this course, participants will have acquired sufficient knowledge and skill to safely conduct a survey on Light Sectors & Floating marking.

## Course Outline

The course includes a theoretical and a practical part with surveying on a ship which participants will be involved in a regular surveying.

Each module begins by stating its scope and aims, and then provides a teaching syllabus.

## Table of Teaching Modules

|  |  |  |
| --- | --- | --- |
| **Module Title** | **Time in hours** | **Overview** |
| **THEORY PART** | **12** | **2 days** |
| Geodesy | 1 |  |
| Satellite Positioning | 1,5 |  |
| Ship System | 1 |  |
| System Accuracy | 2 |  |
| Calibration and Controls | 1 |  |
| Field Survey / Control of floating mark | 1 |  |
| Field Survey / Control of Light Sectors | 2 |  |
| Lighthouse Sectors Mathematics | 0,5 |  |
| Quality Systems/Process System | 0,5 |  |
| Preparation for practical surveying of light sectors | 1,5 |  |
|  |  |  |
| **THEORY PART, WORKSHOP** | **8** | **1 day** |
| Electronic Position fix | 4 |  |
| Post Processing Analysis of the results, reporting | 4 |  |
| **Total Hours:** | **22** | **Total number of days - 3** |

## Specific Course Related Teaching Aids

This course involves both workshop or classroom instruction and a visit to an operational lighthouse. Instruction rooms should be equipped with blackboards or whiteboards, and overhead projectors to enable presentation of the subject matter

## References

In addition to any specific references required by the Competent Authority, the following material is relevant to this course:

# PART B - TEACHING MODULES THEORY PART

The course content in the theoretical part is divided into three levels of knowledge, “Knowledge", “Understanding” and “Information”.

## Module 1 - Geodesy

### Scope

### Learning Objective

### Syllabus

Lesson 1 Fundamental definitions

1. Ellipsoid (GRS80, Bessel, et.c) Information

Lesson 2 Reference systems

1. Geocentric (X, Y, Z) Information
2. Geographic Understanding
3. WGS84 Knowledge
4. UTM Knowledge

Lesson 3 Map Projection

1. Plane coordinates Understanding
2. UTM Information
3. Cylindrical, conical Information
4. Features Information
5. Central Meridian Information
6. Standard Parallels Scale Reduction Factor Information
7. X / Y additions Information

Lesson 4 Transformations

1. Connections by definitions Information
2. Empirical relationships Information

Lesson 5 Meridian Convergence

1 UTM

## Module 2 – Satellite Positioning

### Scope

### Learning Objective

### Syllabus

Lesson 1 Systems

GPS Understanding

GLONASS Information

GALILEO Information

Lesson 2 Principles of Measuring

Absolute measurement Understanding

Relative measurement Understanding

DGPS code measurement Understanding

RTK phase measurement Understanding

Static, post processing Information

Lesson 3 Availability

System owners Information

Planned life Information

Prediction Understanding

Lesson 4 Interference

Ionosphere / troposphere Understanding

Solar Activity Understanding

Electric field Knowledge

Radio interference Knowledge

Multipath Knowledge

Obstructing object Knowledge

Lesson 5 Support system

IALA-DGPS Knowledge

WAAS/EGNOS Information

National Network Services (RTK, DGPS) Knowledge

Lesson 5 Position Accuracy

Individual measurement principles Understanding

Individual combined systems Information

Interference Knowledge

## Module 3 – Ship System

### Scope

### Learning Objective

### Syllabus

Lesson 1 Sensors

GNSS Knowledge

Leading sensor Knowledge

MRU / IMU Knowledge

Lesson 2 Internal Coordinate System

International coordinates Knowledge

Offset Positions Knowledge

## Module 4 - System Accuracy

### Scope

### Learning Objective

### Syllabus

Lesson 1 Measurement

Error in measurement Understanding

Standard Deviation Understanding

Reliability Understanding

Accuracy Understanding

Level of confidence Understanding

Lesson 2 Sensors accuracy

GNSS Knowledge

Heading sensors Knowledge

MRU IMU Knowledge

Internal coordinates Knowledge

Lesson 3 Errors budget

Individual system error Knowledge

Total propagated error Knowledge

Lesson 4 Accuracy Standard

IHO-S44 Understanding

Interpretation Knowledge

Lesson 5 Survey's accuracy

Horizontal position accuracy Knowledge

Propagated errors Knowledge

Position Resolution Knowledge

## Calibration and Controls

### Scope

### Learning Objective

### Syllabus

Lesson 1 System Controls

Individual sensors Knowledge

Lesson 2 Position Controls

Compere to geodetic fix point Knowledge

Lesson3 Documentation

Knowledge

## Field Survey / Control of floating mark

### Scope

### Learning Objective

### Syllabus

Lesson 1 Old methods Understanding

Lesson 2 New methods Knowledge

Lesson 3 Buoy / spar buoy stone position Knowledge

Lesson 4 Swing Knowledge

## Field Survey / Control of Light Sectors

### Scope

### Learning Objective

### Syllabus

Lesson 1 Control of beacon glass

The cutting of the glass Understanding

Adjustment of sectors Understanding

Fixed light Knowledge

Lesson 2 Light

Twilight Knowledge

Light Quality Knowledge

Colors Knowledge

Background light Knowledge

Cleaning of glass Knowledge

Obstructing objects Knowledge

Lesson 3 Sector Boundary Intention

Protect from shallow aria Knowledge

Buoy / spar buoy Knowledge

How far should the sector be leading Knowledge

Lesson 4 Method for measuring sectors Knowledge

Lesson 5 Uncertainty sector

The quality of the sector boundary Knowledge

Maritime safety feature Knowledge

Method for minimize uncertainty Sector Knowledge

Problem Knowledge

## Lighthouse Sectors Mathematics

### Scope

### Learning Objective

### Syllabus

Lesson 1 Calculation with known coordinates of the beacon

Average geometric calculations Information

Lesson 2 Calculating with the unknown coordinates of the beacon

Linear regression (minimum squares method) Information

## Quality Systems/Process System

### Scope

### Learning Objective

### Syllabus

Lesson 1 Local QA-system (ISO9000) Understanding

## Preparation for practical surveying of light sectors

### Scope

### Learning Objective

### Syllabus

Lesson 1 Preparations (checklist)

The mission, analysis, prepare Knowledge

Existing data Knowledge

System Controls Knowledge

Survey system Knowledge

Preparations in the lighthouse Knowledge

Type of surveying (control / complete) Knowledge

Observation offset position Knowledge

Wessel manoeuvring Knowledge

Date and time (sunset – sun rise) Knowledge

Inform shipping (NtM) Knowledge

Weather, wind, waves, visibility Knowledge

# PART B - TEACHING MODULES, **THEORY PART WORKSHOP**

Practical review of the Electronic Position fix with preparation for survey and execution of surveying and analysis of surveying results. Accounting and reporting of the results and analysis of the results compared against existing data.

## Electronic Position fix

### Scope

### Learning Objective

### Syllabus

Lesson 1 Preparations

Maintenance system interface Knowledge

Observation offset position Knowledge

Accepted Surveying conditions Knowledge

Filling in metadata Knowledge

Sector boundary / leading line Knowledge

Type of Surveying, complete / control Knowledge

Planning of observation points Knowledge

Lesson 2 Surveying

Sector observation, border / boundary uncertainty Knowledge

Online control at observations  
(quality of position, probability) Knowledge

Lesson 3 Deviations from originally set values (set points)

Acceptable deviation Knowledge

Significant deviation Knowledge

Navigation Warning, NtM Knowledge

Lesson 4 Liability

Senior Surveyor / Master Knowledge

## Post Processing Analysis of the results, reporting

### Scope

### Learning Objective

### Syllabus

Lesson 1 Analysis

Mathematical stability Knowledge

Redundancy in observations Knowledge

QA Knowledge

Editing of position Knowledge

Lesson 2 Compared against existing data

Lighthouse position Knowledge

Existing databases Knowledge

Chart comparison Knowledge

List of lights Knowledge

Existing bathymetric topography Understanding

Lesson 3 Deviations

Acceptable deviation Knowledge

Significant deviation Knowledge

Navigation Warning, NtM Knowledge

Lesson 3 Liability

Senior Surveyor / post precessing Knowledge

# PRACTICE surveying at sea and closing

### Scope

Surveying on a ship which participants will be involved in a regular surveying.

### Learning Objective

### Syllabus

Lesson 1 xxxxxxx