



# MODEL COURSE

L2.11.1-5

MARINE AIDS TO NAVIGATION - TECHNICIAN  
TRAINING

LEVEL 2 – MARINE AIDS TO NAVIGATION  
STRUCTURES: MATERIALS, CORROSION AND  
PROTECTION

**Edition 2.0**

**December 2017**



# DOCUMENT HISTORY

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

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## FOREWORD

The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) recognises that training in all aspects of Marine 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 R0141 - 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 Level 2 technician functions. This model course on Marine Aids to Navigation structures: materials, corrosion and protection 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 Marine Aids to Navigation structures: materials, corrosion and protection. Assistance in implementing this and other model courses may be obtained from the IALA World-Wide Academy at the following address:

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Tel: (+) 33 1 34 51 70 01  
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Internet: [www.iala-aism.org](http://www.iala-aism.org)

## PART 1- COURSE OVERVIEW

### 1. SCOPE

This course is intended to provide technicians with the theoretical training necessary to understand the materials from which fixed (as opposed to floating) AtoN structures are constructed and how such structures can be protected against the effects of corrosion.

This theoretical course should be completed before the practical course on the preservation of structures (L2.11.6) is undertaken.

This course is intended to be supported by further training modules on the maintenance of floating AtoN and the application of coatings. Details of these supporting model courses can be found in the Level 2 Technician training overview document IALA WWA L2.0.

### 2. OBJECTIVE

Upon successful completion of this course, participants will have acquired sufficient knowledge and skill to understand how materials used in the construction of AtoN structures should be most effectively protected against corrosion and decay.

### 3. COURSE OUTLINE

This mainly theoretical course is intended to cover the knowledge required for a technician to protect fixed AtoN structures from the adverse effects of corrosion and decay. The complete course comprises 5 classroom modules and a test of competence. Each of these deals with a specific subject covering the use of materials used for AtoN structures and how they should be protected.

### 4. TEACHING MODULES

**Table 1** *Table of Teaching Modules*

Module Title	Time in hours	Overview
Aids to Navigation structures	1.0	This module describes the types of fixed AtoN structures operated by their organisation
An introduction to materials	1.0	This module describes the range of materials used in the construction of fixed AtoN structures
Corrosion of structures	2.0	This module describes the factors effecting the corrosion of structures and methods of protection against corrosion
Cathodic protection	1.0	This module describes the use of anodes to protect AtoN structure
Weathering of stone and concrete	1.0	This module describes how stone or concrete structures can be protected against the effects of weathering and corrosion of reinforcement
Evaluation	1.0	Theoretical test of competency
<b>Total Hours</b>	<b>7.0</b>	One-day course



## 5. SPECIFIC COURSE RELATED TEACHING AIDS

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This course will be classroom based. Classrooms should be equipped with blackboards, whiteboards, and overhead projectors to enable presentation of the subject matter.

Examples of the materials used by the organisation in the construction of AtoN structures should be made available for inspection, together with photographs of such structures.

## 6. ACRONYMS

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To assist in the use of this model course, the following acronyms have been used:

<b>AtoN</b>	Marine Aid(s) to Navigation
<b>IALA</b>	International Association of Marine Aids to Navigation and Lighthouse Authorities
<b>L</b>	Level
<b>SOLAS</b>	International Convention for the Safety of Life at Sea, 1974 (as amended)
<b>WWA</b>	World Wide Academy

## 7. DEFINITIONS

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The definition of terms used in this Guideline can be found in the International Dictionary of Marine Aids to Navigation (IALA Dictionary) at <http://www.iala-aism.org/wiki/dictionary>.

## 8. REFERENCES

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

- 1 IALA Guideline G1007 on Lighthouse Maintenance.
- 2 IALA Guideline G1076 on Building Conditioning of Lighthouses.
- 3 IALA Guideline G1077 on Maintenance of Aids to Navigation.
- 4 IALA Guideline G1036 on Environmental Considerations in Aids to Navigation Engineering.
- 5 IALA NAVGUIDE.

## PART 2 – TEACHING MODULES

### 1. MODULE 1 – AIDS TO NAVIGATION STRUCTURES

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#### 1.1. SCOPE

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This module describes the types of fixed AtoN structures operated by their organisation.

#### 1.2. LEARNING OBJECTIVE

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To gain a **satisfactory** understanding of the types and functions of fixed AtoN structures and their components.

#### 1.3. SYLLABUS

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##### 1.3.1. LESSON 1 – ATON STRUCTURES

- 1 Review of fixed AtoN structures [model course L2.1.14].
- 2 Examples of timber structures and piles.
- 3 Examples of masonry and concrete structures.
- 4 Examples of ferrous and non-ferrous structures.
- 5 Examples of GRP and plastic structures.

##### 1.3.2. LESSON 2 – STRUCTURE COMPONENTS

- 1 Ladders.
- 2 Platforms.
- 3 Towers.

### 2. MODULE 2 – AN INTRODUCTION TO MATERIALS

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#### 2.1. SCOPE

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This module describes the range of materials used in the construction of fixed AtoN structures.

#### 2.2. LEARNING OBJECTIVE

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To gain a **satisfactory** understanding of the types of materials used in AtoN structures and their advantages and disadvantages.

#### 2.3. SYLLABUS

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##### 2.3.1. LESSON 1 – TIMBER

- 1 Advantages of timber structures.
- 2 Disadvantages of timber structures.
- 3 Use of steel fasteners and wire ropes.

##### 2.3.2. LESSON 2 - MASONRY AND CONCRETE

- 1 Properties of quarry stone.
- 2 Brickwork.
- 3 Concrete block.
- 4 Reinforced concrete.





5 Advantages and disadvantages of masonry and concrete.

### 2.3.3. LESSON 3 – FERROUS AND NON-FERROUS METALS

- 1 Steel.
- 2 Stainless steel.
- 3 Aluminium.
- 4 Advantages and disadvantages of metals used for AtoN structures.

### 2.3.4. LESSON 4 - GRP, PLASTIC AND RUBBER

- 1 Use, advantages and disadvantages of GRP.
- 2 Use, advantages and disadvantages of polyethylene plastics.
- 3 Use, advantages and disadvantages of rubber.

## 3. MODULE 3 – CORROSION OF STRUCTURES

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### 3.1. SCOPE

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This module describes the factors effecting the corrosion of structures and methods of protection against corrosion.

### 3.2. LEARNING OBJECTIVE

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To gain a **basic** understanding of the effects of corrosion on materials used for AtoN structures.

### 3.3. SYLLABUS

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#### 3.3.1. LESSON 1 – ROT, DECAY AND CORROSION OF TIMBER AND METAL FASTENERS

- 1 Fungal rot.
- 2 Marine borer and insects.
- 3 Microporous coatings.
- 4 Connector and fastener corrosion.
- 5 Impact damage.

#### 3.3.2. LESSON 2 - CORROSION OF METAL STRUCTURES (PART 1)

- 1 Electro-chemical corrosion.
- 2 Corrosion and coating loss.
- 3 Abrasion.
- 4 Loosening of structural connections.
- 5 Missing bolts.
- 6 Metal fatigue and failure.
- 7 Overloading.
- 8 Loss of foundation metal.

#### 3.3.3. LESSON 3 – CORROSION OF METALS (PART 2)

- 1 Galvanic corrosion.
- 2 Isolating dissimilar metals.



- 3 Abrasion and wear.
- 4 Microbial corrosion.

## 4. MODULE 4 – CATHODIC PROTECTION

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### 4.1. SCOPE

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This module describes the use of anodes to protect AtoN structures.

### 4.2. LEARNING OBJECTIVE

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To gain a **basic** understanding of the types and functions of sacrificial anodes and their application in the protection of fixed steel structures.

### 4.3. SYLLABUS

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#### 4.3.1. LESSON 1 – SACRIFICIAL ANODES

- 1 Basic theory of sacrificial anodes.
- 2 Applications of Cathodic protection.

#### 4.3.2. LESSON 2 - FITTING CATHODIC PROTECTION

- 1 Types of anodes.
- 2 Fitting anodes.

#### 4.3.3. LESSON 3 – ACTIVE CATHODIC PROTECTION SYSTEMS

- 1 Impressed current.
- 2 Inspection and testing.

## 5. MODULE 5 – WEATHERING OF STONE AND CONCRETE

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### 5.1. SCOPE

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This module describes how stone or concrete structures can be protected against the effects of weathering and corrosion of reinforcement.

### 5.2. LEARNING OBJECTIVE

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To gain a **basic** understanding of the effect of weathering on stone and concrete.

### 5.3. SYLLABUS

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#### 5.3.1. LESSON 1 – CAUSES OF STONE DETERIORATION

- 1 Gravity-related debris release.
- 2 Salt action.
- 3 Crustaceans.

#### 5.3.2. LESSON 2 - PROTECTION AGAINST STONE DETERIORATION

- 1 Removal of vegetation.
- 2 Humidity control and airflow.

#### 5.3.3. LESSON 3 – CONCRETE CORROSION

- 1 Problems with internal reinforcement.



2 Identification of corrosion mechanism in concrete.

## 6. ASSESSMENT

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A short written test of competency will be undertaken by participants on completion of Module 5. It is recommended that a period of 30 minutes' revision will be given before this test is undertaken. Participants who complete this test successfully can then proceed to the practical Model Course L2.11.6 – Preservation of structures.