



IALA MODEL COURSE

L2.2.7

AIDS TO NAVIGATION - TECHNICIAN TRAINING

LEVEL 2 MODULE 2 ELEMENT 2.7

LIGHTNING PROTECTION

Edition 2.0

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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 Organization, 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 AtoN Service Craft and Buoy Tenders 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 an introduction to service craft and buoy tenders. 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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PART 1 - COURSE OVERVIEW

1. SCOPE

This course is intended to provide technicians with the theoretical and practical training necessary to have a satisfactory understanding of the factors influencing effective lightning protection and the maintenance necessary to ensure a safe and effective system.

This course is intended to be supported by further practical training modules on power supply and maintenance records. 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 to understand the reasoning behind lightning protection, understand how to fit equipment within a lightning protection system and how to maintain an effective operational system.

3. COURSE OUTLINE

This principally theoretical course is intended to cover the knowledge required for a technician to understand the components of a lightning protection system and their application on different structures. The complete course comprises of 6 classroom modules, each of which deals with a specific subject concerning lightning protection. Teaching Module 7 is optional for those organisations who wish their technicians to have a more practical understanding of the maintenance of a lightning protection system. Each module begins by stating its scope and aims, and then provides a teaching syllabus.

4. TEACHING MODULES

Table 1 Table of Teaching Modules

Module Title	Time in hours	Overview
Introduction to lightning protection	2.0	This module describes how lightning is produced, its effects, how this can be managed and the influences of location
Risk assessment	1.0	This module outlines the factors influencing the decision to fit lightning protection
Physical protection design	2.0	This module describes how the energy is managed
Surge protection design	2.0	This module describes the manner of limiting the effect of voltage differentials
Examples of good design practice for AtoN	3.0	This module provides good examples of how lightning protection is applied to AtoN
Lightning protection system maintenance	1.0	This module explains the periodic steps to be taken to effectively maintain a system

Module Title	Time in hours	Overview
Practical maintenance of a lightning protection system	2.0	This practical module demonstrates how to maintain an effective lightning protection system (Optional)
Evaluation	1.0	Written test
Total Hours	12.0 or 14.0	Two-day / three-day course

5. SPECIFIC COURSE RELATED TEACHING AIDS

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

The course should preferably include a visit to a lighthouse with a suitable lightning protection system and the use of earth resistance measuring equipment.

6. ACRONYMS

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

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

7. DEFINITIONS

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

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

- 1 IALA NAVGUIDE.
- 2 IALA Guideline 1012 on The Protection of Lighthouses and Aids to Navigation against Damage from Lightning.
- 3 Manufacturers' handbooks on earth resistance measuring equipment used by the organisation.

PART 2 – TEACHING MODULES

1. MODULE 1 – INTRODUCTION TO LIGHTNING PROTECTION

1.1. SCOPE

This module describes how lightning is produced, its effects, how this can be managed and the influences of location.

1.2. LEARNING OBJECTIVE

To gain a **basic** understanding of what lightning is and how this varies with location, plus an understanding of the effects of a strike and how this can be managed.

1.3. SYLLABUS

1.3.1. LESSON 1 – THE NATURE OF LIGHTNING AND THE EFFECTS OF LOCATION

- 1 What is lightning?
- 2 How is it generated?
- 3 Downward leaders.
- 4 Upward streamers.
- 5 Energy in a strike.
- 6 Keraunic level.

1.3.2. LESSON 2 – IMPACT OF A STRIKE AND HOW THIS CAN BE MANAGED

- 1 Thermal effect.
- 2 Electrodynamic effect.
- 3 Rise in Earth potential.
- 4 Physical protection.
- 5 Surge protection.
- 6 Passive protection.

2. MODULE 2 – RISK ASSESSMENT

2.1. SCOPE

This module describes the factors influencing the decision to fit lightning protection.

2.2. LEARNING OBJECTIVE

To gain a **satisfactory** understanding of the risk assessment process to determine the cost-effective level of lightning protection.

2.3. SYLLABUS

2.3.1. LESSON 1 – WHY ASSESS RISK?

- 1 Likelihood of strike.
- 2 Impact of strike.
- 3 Effect of strike.

- 4 Typical system cost.
- 5 Outcome from the risk assessment.

3. MODULE 3 – PHYSICAL PROTECTION DESIGN

3.1. SCOPE

This module describes how the energy of a lightning strike can be managed to limit the effects of damage to a structure. It will provide an understanding of how methods can be used to achieve the necessary protection.

3.2. LEARNING OBJECTIVE

To gain a **basic** understanding of the design approach to achieve physical lightning protection.

3.3. SYLLABUS

3.3.1. LESSON 1 – PROTECTION METHODS

- 1 Goals of physical protection.
- 2 Protection angle method.
- 3 Rolling sphere method.

3.3.2. LESSON 2 - PRACTICALITIES

- 1 Air termination networks.
- 2 Materials.
- 3 Down conductors, ring conductor and bonding.
- 4 Types of earth electrodes.

4. MODULE 4 – SURGE PROTECTION DESIGN

4.1. SCOPE

This module describes how equipment within a structure can be protected to minimise the effects of a lightning strike.

4.2. LEARNING OBJECTIVE

To gain a **basic** understanding of zones of protection, the selection of surge arrestors and how equipotential bonding is important to managing lightning surges.

4.3. SYLLABUS

4.3.1. LESSON 1 – VOLTAGE SURGES

- 1 How electronic equipment is damaged.
- 2 Sources of surge voltage.
- 3 Surge profile.

4.3.2. LESSON 2 - SURGE MANAGEMENT

- 1 Surge protection zones.
- 2 Equipotential bonding.
- 3 Surge arrestor selection.

- 4 Rules to good zoning design.

5. MODULE 5 – EXAMPLES OF GOOD DESIGN PRACTICE FOR AtoN

5.1. SCOPE

This module describes practical examples of good lightning protection design on lighthouses and how to manage given some of the physical constraints.

5.2. LEARNING OBJECTIVE

To gain a **satisfactory** understanding of how to achieve a good lightning protection system.

5.3. SYLLABUS

5.3.1. LESSON 1 – PHYSICAL PROTECTION

- 1 Roof structures, down conductor and ground rings.
- 2 External masts and towers.
- 3 PV array framework and other independent buildings.
- 4 Earth electrodes.

5.3.2. LESSON 2 - SURGE PROTECTION & EQUIPOTENTIAL BONDING

- 1 Protective zoning.
- 2 Managing incoming services.
- 3 Antennas and fire system circuits.
- 4 Bonding of equipment, cubicles, cable distribution and station earth.

5.3.3. LESSON 3 – STRUCTURAL STEELWORK AND EQUIPMENT

- 1 Buried Reinforcing.
- 2 Weight tube and hand railings.
- 3 Alternators and fuel tanks.
- 4 Audible signal stacks.
- 5 Radar antennas.

6. MODULE 6 – LIGHTNING PROTECTION SYSTEM MAINTENANCE

6.1. SCOPE

This module covers all aspects associated with periodic inspection and maintenance of a lightning protection system.

6.2. LEARNING OBJECTIVE

To gain a **satisfactory** understanding of the periodic steps needed to maintain and inspect a lightning protection system.

6.3. SYLLABUS

6.3.1. LESSON 1 – PHYSICAL PROTECTION

- 1 Inspection and Testing.

- 2 Protective zoning.
- 3 Managing incoming services.
- 4 Antennas and fire system circuits.
- 5 Bonding of equipment, cubicles, cable distribution and station earth.

7. MODULE 7 – PRACTICAL MAINTENANCE OF A LIGHTNING PROTECTION SYSTEM

7.1. SCOPE

This optional **practical** module covers the steps taken to maintain a good lightning protection system ideally with a visit to a lighthouse with a suitable system.

7.2. LEARNING OBJECTIVE

To participate in and gain a **satisfactory** understanding of how to inspect and test lightning protection systems.

7.3. SYLLABUS

7.3.1. LESSON 1 – EARTH ELECTRODE TESTING

- 1 Testing of earth electrodes – Methods.
- 2 Calculating earth electrode resistance.

7.3.2. LESSON 2 – INSPECTIONS

- 1 Inspection of physical protection – Things to look for.
- 2 Inspection of surge arrestor – Things to look for.
- 3 Inspection of equipotential bonding.
- 4 Maintenance records.