

IALA World-Wide Academy

Model Course for Aids to Navigation

LEVEL 2 Technician Training

Lightning Protection Module 2 Element 2.7 (IALA WWA L2.2.7)

Edition 1.0

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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.

Date	Page / Section Revised	Requirement for Revision

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.

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 international recommendations and guidelines when establishing aids to navigation. As such publications should include recommendations on the 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 lightning 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 lightning 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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1 PART A - COURSE OVERVIEW

1.1 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.

1.2 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.

1.3 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.

1.4 Table of Teaching Modules

Module Title	Time in hours	Overview
Introduction to lightning protection	2	This module describes how lightning is produced, its effects, how this can be managed and the influences of location.
Risk assessment	1	This module outlines the factors influencing the decision to fit lightning protection
Physical protection design	2	This module describes how the energy is managed
Surge protection design	2	This module describes the manner of limiting the effect of voltage differentials
Examples of good design practice for AtoNs	3	This module provides good examples of how lightning protection is applied to AtoNs
Lightning protection system maintenance	1	This module explains the periodic steps to be taken to effectively maintain a system
Practical maintenance of a lightning protection system	2	This practical module demonstrates how to maintain an effective lightning protection system
Evaluation	1	Written test
Total Hours:	12 or 14	Total number of days 2 or 3

1.5 Specific Course Related Teaching Aids

- 1 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.
- 2 Visit to a lighthouse with a suitable lightning protection system.
- 3 Earth resistance measuring equipment.

1.6 References

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

- IALA NAVGUIDE Section 7.4.2
- IALA Guideline 1012 on The Protection of Lighthouses and Aids to Navigation against Damage from Lightning
- Manufacturers' handbooks on earth resistance measuring equipment used by the organisation

2 PART B - TEACHING MODULES

2.1 Module 1 – Introduction to lightning protection

2.1.1 Scope

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

2.1.2 Learning Objective

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

2.1.3 Syllabus

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

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

2.2 Module 2 – Risk Assessment

2.2.1 Scope

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

2.2.2 Learning Objective

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

2.2.3 Syllabus

Lesson 1 Why Risk Assess

- 1 Likelihood of strike
- 2 Impact of strike
- 3 Effect of strike
- 4 Typical system cost
- 5 Outcome from the risk assessment

2.3 Module 3 – Physical Protection Design

2.3.1 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.

2.3.2 Learning Objective

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

2.3.3 Syllabus

Lesson 1 Protection Methods

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

Lesson 2 Practicalities

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

2.4 Module 4 – Surge Protection Design

2.4.1 Scope

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

2.4.2 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.

2.4.3 Syllabus

Lesson 1 Voltage Surges

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

Lesson 2 Surge Management

- 1 Surge protection zones
- 2 Equipotential bonding
- 3 Surge arrestor selection
- 4 Rules to good zoning design

2.5 Module 5 - Examples of good design practice for AtoNs

2.5.1 Scope

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

2.5.2 Learning Objective

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

2.5.3 Syllabus

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

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

Lesson 3 – Structural Steelwork and Equipment

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

2.6 Module 6 – Lightning Protection System Maintenance

2.6.1 Scope

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

2.6.2 Learning Objective

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

2.6.3 Syllabus

Lesson 1 Inspection and Testing

- 1 Testing of earth electrodes – Hazards, goals and constraints
- 2 Inspection of physical protection – Things to look for.
- 3 Inspection of surge arrestors – Things to look for.
- 4 Equipotential bonding and extraneous metal parts
- 5 Records
- 6 Local requirements – Insurance/ local regulation

2.7 Module 7 – Practical maintenance of a Lightning Protection System

2.7.1 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.

2.7.2 Learning Objective

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

2.7.3 Syllabus

Lesson 1 Earth Electrode Testing

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

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