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| IALA Guideline |

G1???

on Properties of a good marine solar panel

Edition 1.0

Document date

Revisions to this 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 |
| Mar 21 | All | New guideline |
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|  |  |  |
|  |  |  |
|  |  |  |

1 Introduction 6

2 Scope 6

3 Use of solar panels as power source for aton – Peter D 6

4 Technology 7

4.1 Solar panel technologies – Monocrystalline vs Polycrystalline panels 7

5 Design 8

5.1 Number of cells 8

5.2 Intercell connection 8

5.3 Colour 8

5.4 Panel Efficiency 8

6 Developments 8

7 Operation 9

7.1 MPPT 9

7.2 PWM 9

7.3 Impact of solar regulation 9

7.4 Operating conditions – Part of environmental factors? 9

8 Application – is this need or should it be combined with installation? 9

8.1 Self-contained 9

8.2 Buoy 9

8.3 Lighthouse 9

8.3.1 Grid connected systems 9

8.3.2 Islanding system 9

8.3.3 DC floating system 9

9 Environmental factors 9

9.1 Materials used in production 9

9.2 Deposits 9

9.2.1 Bird Foul (Guano) 9

9.2.2 Salt 9

9.2.3 Dust 9

9.3 Temperature 10

9.4 Humidity 10

9.5 Irradiance 10

9.6 Atmospheric Effect 10

9.7 Poor levels of visibility 11

9.8 EMC impact (Lightning) 11

9.9 climate change impacts 11

10 Installation 11

10.1 Mounting methods 11

10.2 Orientation 11

10.3 Shadowing/Shading 11

10.4 AC connected – IS this used in a marine environment? 12

10.5 Identification of modules 12

11 Problems / failures 13

11.1.1 If lightning strikes : 13

11.2 Micro cracking – wind pressure 14

11.3 Sealant failure 14

11.4 Cell corrosion 14

11.5 Metal corrosion 14

11.6 Poor insulation 14

11.7 Ice 14

11.8 Theft of modules and ways to prevent it 14

11.9 Connector failure and use of connectors and types 15

12 Maintenance and testing 15

12.1 Equipment and measurement devices – Some info from Peter S 15

12.2 Life / aging 15

13 Procurement 15

13.1 Assessment 15

13.1.1 The guarantee: 15

13.1.2 Price list : 15

13.1.3 Manufacturer 16

14 Standards 16

15 DEFINITIONS 16

16 ACRONYMS 16

17 REFERENCES 16

18 documentation 18

18.1 proofs 18

18.2 references 18

18.3 datasheet 18

18.4 (Example Heading level 2) 18

18.5 (Example Heading level 2) 18

19 AIMS AND OBJECTIVES (Example Heading level 1) 18

20 Example Heading level 1 18

20.1 (Example Heading level 2) 20

20.1.1 (Example heading level 3) 20

21 Example Heading level 1 20

21.1 TABLES 20

22 FIGURES 21

23 DEFINITIONS 22

24 ACRONYMS 22

25 REFERENCES 22

ANNEX A EXAMPLE OF AN ANNEX - LANDSCAPE 23

APPENDIX 1 EXAMPLE OF AN APPENDIX TITLE 24

ANNEX B (EXAMPLE ANNEX TITLE) 25

ANNEX C PERMITTED COLOUR PALETTE 26

List of Tables

Table 1 Example of a table caption; table with the significant information in the first column 20

Table 2 Example of a table caption; table with the significant information in the first row 21

Table 3 Example of a table caption; table with coloured rows 21

Table 4 Example table caption 23

List of Figures

Figure 1 Component of a solar system by Rfassbind - Own work, Public Domain, 7

Figure 2 Diagram of atmospheric effects. 11

Figure 3 Example figure caption 21

Figure 4 Another example figure caption 22

List of Equations

Equation 1 Geographical range 20

Equation 2 Theory of Special Relativity 20

# Introduction

The use of solar panels on marine aids to navigation (AtoN) dates back to the end of the 1980s, where the goal was to adopt a clean renewable energy source. This source of energy allowed the powering of remote and afloat AtoN and the removal of gas such as Acetylene powered light sources, which required periodic replacement of gas holders, at a significant number of locations over the years since.

Since these early days, the development of solar panels has made significant strides, moving from niche areas as small off grid systems, to the mainstream power production, in the form of grid connected “solar farms”. This has delivered great enhancement in solar cell efficiency and a reduction in manufacturing costs, but it has resulted in manufacturers focussing their products toward this high-volume market.

Naturally, the demands and requirements for such high volume “solar farm” panels differ to that required in a remote location marine environment. This has resulted in the challenge of trying to identify the qualities that make a good marine solar panel from that presented in a data sheet of the more mainstream panel. This guideline hopes to identify the area that are important to a survivable marine solar panel.

# Scope

This guideline has been developed to assist marine aids to navigation (AtoN) manufacturers and authorities when selecting and applying solar modules to power systems in a marine environment. It is intended to inform the reader about factors influencing performance and reliability, as well as considering aspect of selection and purchasing.

# Use of solar panels as power source for aton – Peter D

Although the first solar panel was created in 1881 by Charles Fritts, it was not until 1957 that the first commercial solar cells became available. This technology was fist adopted on aids to navigation (AtoN) in the mid 1980, generally as trials, leading to adoption in the mainstream as a source of power for AtoN by the mid 1990, initially leading to the replacement of small acetylene gas AtoN.

As the efficiency of solar cells has developed through the expansion of commercial main stream solar modules for such things as housing and solar farms, so this has allow solar to be adopted for significantly higher demand system at one end of the power spectrum and the development of small self-contained AtoN often referred to as Integrated power systems (IPS) at the. other.

As the power demand of a solar system expands so the number cells need expands. How these expanding systems refer to different components is captured in figure 1, starting from solar cells used on an IPS to solar arrays used on a larger lighthouse installation.

When considering designing a photovoltaic power system, IALA provide a guideline G1067 on how to design a photovoltaic power system.

* What about GRID, Island and DC floating
* Purpose of solar modules
* Advantages/disadvantages

A close up of text on a white background

Description automatically generated

1. Component of a solar system by Rfassbind - Own work, Public Domain,

* The quality of photovoltaic solar panels:

The quality of the photovoltaic solar panels is an important factor to consider for any rooftop or ground-mounted solar power plant project. Indeed, the quality of the chosen photovoltaic modules will determine the payback time of your solar power plant by guaranteeing you an optimum production of solar energy in the long term.

* How to recognize the best photovoltaic panels on the market?

It is difficult for a neophyte to verify the quality of a solar panel only by checking the visual aspect. Indeed, several criteria such as standards and technical specifications will have to be checked to ensure the reliability of his photovoltaic solar panel.

# Technology

Monocrystalline

Polycrystalline

Thin film / flexible modules

## Solar panel technologies – Monocrystalline vs Polycrystalline panels

Crystalline silicon PV cells are the most popular solar cells on the market today and provide the highest energy conversion efficiencies of all commercial solar cells and modules. Silicon is safe for the environment and one of the most abundant resources on Earth. Monocrystalline and Polycrystalline panels are both types of solar cells that are made from crystalline silicon and the most commonly used crystalline silicon solar cells. Monocrystalline panels, as the name suggests, are created from a single continuous crystal structure. Monocrystalline solar panels typically have the higher efficiency rates since they are made out of a higher-grade silicon and their single-cell structure creates minimal resistance to the flow of electricity once the electrons are excited by the sun. Solar panels are constructed using a collection of each of these types of cells. It was once the case that polycrystalline solar panels were 20-30% cheaper than monocrystalline solar panels because producing monocrystalline cells was a more expensive process than producing polycrystalline cells, this however is no longer the case with the price difference between the technologies being negligible. With all solar cells, electricity production falls as temperature goes up. Studies have shown that in the summer months with high temperature, polycrystalline and monocrystalline modules perform similar however, in non-summer months, even with similar irradiance, monocrystalline modules perform better then polycrystalline modules. The choice between monocrystalline and polycrystalline solar panels is not considered a critical factor when purchasing solar panels unless modules are susceptible to long periods of low irradiance in which case monocrystalline panels would be recommend over polycrystalline.Construction of modules

Polycrystalline, Monocrystalline or Amorphous? Which solar cell technology did you choose and why? Make sure that the solar panel technologist meets your needs and expectations and that it is adapted to the production context of your solar power plant.

# Design

## Number of cells

## Intercell connection

## Colour

Not normally used but colour are available Peter S to provide a photo.

Shock and vibration

## Panel Efficiency

The portion of sunlight energy that can be converted into electricity via photovoltaics by the solar cell. For example: a solar panel with 15% efficiency and an area of 1 m² will only produce 150W at Standard Test Conditions (STC).

It is a criterion to be considered according to your context of installation, the rate expressed as a percentage will indicate you the ratio between the production produced and the power of the radiation captured by the solar panels. The efficiency of photovoltaic solar panels varies according to several determining factors, but generally it is between 12 and 20%. Attention there are very good solar panels with yields at 12%, the yield is not to be considered to determine the quality of the equipment but rather to help you in the choice of photovoltaic modules according to your solar installation configuration. The reduced surface area available for roof or ground installations will favour the choice of panels with high yields while the greater availability of surface area will make the choice of a solar panel with a lower yield and therefore with a more accessible tariff.

* Diodes
* Cell type (refer to IALA G1039/1.1.1 TYPES OF SOLAR CELLS)
* Construction of modules
* String design

# Developments

Perovskite cell

Double sides solar cells

# Operation

## MPPT

## PWM

## Impact of solar regulation

## Operating conditions – Part of environmental factors?

# Application – is this need or should it be combined with installation?

## Self-contained

## Buoy

## Lighthouse

### Grid connected systems

### Islanding system

### DC floating system

# Environmental factors

Although solar panels appear to be an inert object with a glass surface, no moving parts all held together in a frame, it is influence by its operating environment for both performance and operational longevity. This section outlines the key factor to consider.

Two major factors that affect solar panel performance under normal circumstances are Irradiance and Temperature. There are also other factors that are area dependent like Shadowing and environmental factors like Salt film, Dust and Bird Foul (Guano).

## Materials used in production

## Deposits

Snow, sand, pollution deposits

### Bird Foul (Guano)

While it is possible to prevent birds from landing on the solar panels using bird deterrent i.e. bird spikes, etc, they can still drop their droppings while flying. Over time if not rid of, it will become harden and form a similar shading effect that can drastically affect the panel’s efficiency.

### Salt

To prevent a salt film and dusts from forming on the panel’s surface, it is recommended to install the panels at an angle to induce a natural washing effect when the rain comes. This will help wash away the salt that is gathered on the surface.

### Dust

Dust is an issue in certain extremely hot environments and can cause several issues.

Dust can cover lanterns and day marks, severely impacting the range, can cover solar panels thereby reducing the ability to charge batteries and its abrasive nature can accelerate deterioration of AtoN components.

Dust can be of different physical properties, both industrial and natural, can cause different issues and require different controls and cleaning methods.

Excessive dust also poses health and safety related risks to AtoN personnel. refer to IALA G116 / 2.2.7. DUST

## Temperature

One of the factors affecting solar panels is temperature that is generally caused by the environmental effects. Depending on the location, those at the north and south generally get colder climate at the expense of the daily available sun hours. This means that the solar panels perform at optimum efficiency due to the lower operating temperature. However, those panels that are installed nearer to the equator generally get hot all year round which translate to a drop in the panel’s efficiency.

The output voltage of a module is affected by the cell temperature and changes in a similar way as the output power. Therefore, every solar panel has its own thermal characteristics derived under Standard Testing Condition to measure the loss known as the “temperature coefficient”. Generally, it is given as -0.45%/°C for Monocrystalline and -0.50%/°C for Polycrystalline panel. Refer to IALA G1136 / 5.1.3. SOLAR PANEL PERFORMANCE for more info.

* Temperature: refer to G1039 / 1.1.4 TEMPERATURE INFLUENCE and 1.1.5 THERMAL CHARACTERISTICS

7 - Temperature coefficient :

The temperature coefficient indicates the electrical behaviour of your solar panel from a standard operating temperature of 25°. The units of this coefficient are expressed in "% per ° C", so the lower the coefficient, the more efficient the solar panel is. Conversely, the higher the number, the less the photovoltaic module will produce in case of strong heat or early afternoon.

A high temperature coefficient is the sign of a solar panel of lower quality. A reasonable number is around 0.5%, so the best solar panels go down to 0.3%, while 0.7% indicates a poor coefficient in terms of performance and therefore a photovoltaic equipment not very reliable.

Hot and cold impacts efficiency. Higher temperatures result in ADD diagram of what this means

Colder temperatures enhance efficiency, but battery storage reduces??

High levels of UV- does this have an impact on life through breakdown of PN junction?

## Humidity

## Irradiance

Irradiance is known as the amount of solar power available per unit area. Symbol = I. Its units are represented by kW/m² or mW/m². It is one of the major factors that affects the performance of solar panels. How we install each panel to face the sun is very important. Due to geometric effects, it is always recommended that each panel is facing 90° perpendicular to the sun’s altitude angle (when it is at the highest point in the sky) to ensure that the panel can capture all the sun’s radiation.

## Atmospheric Effect

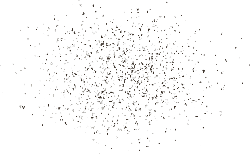
Atmospheric Effects consists of two categories, Direct and Diffuse Radiation. The photo below to illustrate the concept easier.

1. Diagram of atmospheric effects.

Solar constant = 1.36kW/m²

solar radiation at surface = 1kW/m²

Sun



Reflected solar radiation (albedo) from atmosphere

Dust particles

Clouds

Direct solar radiation

Diffused solar radiation

Atmosphere entry point

Earth’s surface

## Poor levels of visibility

Pollutants can have the same impact, less of an issue offshore, but could be on inland waterways through built up areas

Performance factors

## EMC impact (Lightning)

Damage can occur to your photovoltaic system due to a direct lightning strike or nearby. Investing in protection is all the more advisable if your installation is expensive. Lightning protection will be prioritized at lighthouse sites located in areas where the risk of lightning strikes is highest. In order to know the probability of lightning strikes, it is advisable to use a kerunic level map of the place in order to define the level of protection that will be adapted

## climate change impacts

Refer to Guideline GYYYY

# Installation

Size, weight, power, efficiency, performance

Self contained Vs discrete panels

Safety and handling

## Mounting methods

## Orientation

* Refer to G1039 / 1.1.6 SOLAR PANEL ORIENTATIONDisposal/ recycling

## Shadowing/Shading

It is always recommended to install arrays that have clear line of sight to the sun. Any shadowing caused by nearby buildings or trees can cause a significant reduction in maximum power point voltage therefore a reduction in the maximum power available from the array. Although temporary, meteorological factors like passing clouds caused during overcast days also affects the panels efficiency.

Solar panels should be usually oriented toward the equator to maximise power output. The tilt angle should be chosen with regard to insolation, geographic location, self‐cleaning capabilities, available space, etc.

In the case of floating Marine Aids to Navigation it is not possible to guarantee the orientation of the modules, so a reduction factor must be applied.

It should also be considered that solar modules are sensitive to the presence of small shadows, even a narrow shadow can significantly decrease the output power. For example shadows generated by vegetation, buildings, daymarks and handrails can cause problems and should be avoided.

In some locations, fouling of the surface may be an issue. In these locations, it is recommended to avoid horizontal placement and that solar panels are installed with an inclination that promotes self‐cleaning. refer to IALA G1039 / 1.1.6 SOLAR PANEL ORIENTATION

## AC connected – IS this used in a marine environment?

* Refer to G1039 / 1.1.3 CURRENT ‐ VOLTAGE CURVE

6 - Power tolerance:

This is the amount of power in real output of your solar panel. For example a 165W module with a +/- 5% tolerance could actually produce from 156.75W up to 173.25W.

The best photovoltaic solar panels have a "positive only" power tolerance, which means that you are guaranteed to get at least the specified output power from the panel.

For example: a 200W solar panel with a tolerance of +5% / - 0% will produce a minimum of 200W and a maximum of 210W.

* Resistance to earth
* Types and quality of the connection cable
* Connectors
* IP67/68
* Junction box (disadvantages, fixing, tests….)

9 - The Boitier by Pass and the cables :

Turn the module over to inspect the finish of the By pass box. It must be siliconized in the correct way and the appropriate cable diameter. Check the By-pass diodes that will allow the solar panel to continue to produce even if there is shade on part of the solar panel.

• Plugs

* Connecting the cells
* Product history
* Cable size from JB

Construction and material of junction box

## Identification of modules

* Date of manufacturing
* Manufacturer
* Electrical performance
* Materials

8 - The frame of the solar panel :

Visually, a quality solar panel frame must result in an exemplary finish. The contacts at the corners must be joined and anodised to guarantee protection against corrosion. Finally the edges must not be sharp and the design must be refined for aesthetic integration on a roof.

* Quality of materials
* Shock/vibration test/standards
* Construction and forces
* Surface finish
* Self-cleaning
* Types of construction: glas/glas, glas/metal, flexible
* Wind loading and handling

10 - The protective film :

At the back of the module is the protective film, check that there are no air bubbles and that

# Problems / failures

Water ingress

Diodes

Lightning protection

### If lightning strikes :

* - less than 500m away, overvoltages are induced by magnetic fields on your entire electrical installation.
* - Indirectly: the installations and the various electrical circuits can suffer serious damage.
* - directly: the high current destroys electrical installations with fire risks.
* The external protection is used to protect against the direct impacts of lightning. It consists of a lightning conductor system. The lightning conductors capture the lightning and conduct the current to the earth. Long rods made of conductive metal are used which protrude above the photovoltaic installation to be protected.

Interior protection is the use of devices to protect against currents and magnetic fields that can damage interior installations. The essential device is the earthing system, which prevents discharges from passing through the electrical installations. At the photovoltaic installation level it is necessary to :

If your installation is not directly exposed:

* -connect the frame of the modules to the earthing circuit.
* -connect the frame of the photovoltaic module to the ground by an electric wire on the outside of the building.
* -and of course, lead the grounding circuit to the grounding bar using a low impedance device.

If your installation is directly exposed:

* connect the frame of the module to the lightning conductor with a wire capable of withstanding the lightning current direct the discharges to the grounding circuit with a lightning arrester installed before the DC input line of the inverter.
* For more information about lightning you can use Guideline 1012 Ed 3.
* And specifically, Paragraph 7.6.4 SOLAR PHOTOVOLTAIC ARRAYS:

Photo‐voltaic (PV) arrays are vulnerable to lightning damage, particularly where they are located at a distance from the main building. A separate earth termination should be installed locally, connected to the array mounting frame. This should be bonded to the main lightning earth using a bonding conductor of not less than 50 mm2, which should follow closely the route of the DC cables between the photovoltaic array and the main building. When assessing this requirement, the rolling sphere technique (see Table 1) should be used based on the required lightning protection level and taking account of the location of the photovoltaic array.

All cables should be run either on cable tray, in conduit/trunking or tightly against earthed metalwork/conductor tapes.

## Micro cracking – wind pressure

Stresses

Water ingress

## Sealant failure

## Cell corrosion

## Metal corrosion

Dissimilar material corrosion

## Poor insulation

Mechanical impacts caused by handling and shock/vibration

## Ice

Peter S has some photos of solar panels with ice. Peter to send presentation of panels with damage.

Immersion in water and water jetting for cleaning

Wavewash refer to G1136 / 2.2.4. b EXTREME WEATHER EVENTS

## Theft of modules and ways to prevent it

Although in recent years there has been a considerable reduction in the theft of solar modules due mainly to the sharp decline in the purchase costs of panels, the replacement costs due to logistics for modules located in remote and difficult to access locations remains high and represents a very important consideration in the design of a photovoltaic installation. The risk of theft or unauthorised use of photovoltaic modules installed at AtoN sites warrants consideration of an effective anti-theft solution to protect the photovoltaic panels. The most commonly used method for securing solar panels is the use of security fixing screws in the end and mid clamps of the solar mounting system. The fixings require a special insert bit or key wrench to remove the clamps securing the panels to the mounting frame.

## Connector failure and use of connectors and types

# Maintenance and testing

See model course

Cleaning and surface finishes (self cleaning)

## Equipment and measurement devices – Some info from Peter S

Checking performance

Measurement methods

On/off site

Frequency

Standards

* Certification

You have obtained the certificates, certificates of standards, laboratory tests and the quotation, then it will be wise to go through the documents and data sheet of the photovoltaic module and check the following 10 points:

## Life / aging

Replace on age or performance.

Performance over life 90% after 10 years 80% after 15 years.

Performance testing over the life

Refer to IALA G1039 /1.1.2 LIFESPAN

* Operational life
* Performance life

# Procurement

How to specify

## Assessment

### The guarantee:

The manufacturer must at least offer you a solar panel with a minimum 25-year guarantee. What is the procedure for replacing my solar panel in case of failure? It is a good idea to ask the installer or the manufacturer if you have difficulty obtaining information on this subject, then it is a bad sign.

### Price list :

The cost of a photovoltaic solar panel is normally expressed in cost per Wc. Example: 0.85 euros/Wp for a 250 Wp solar panel which indicates a unit price of 212.50 euros.

Beware of very low rates on solar panels, it is generally the sign of a minimum quality equipment with sometimes dubious guarantees. Do not hesitate to ask for several quotes from several distributors or installers in order to compare.

### Manufacturer

Try to find out about the reputation of the solar panel manufacturer in search engines. How long has it been in the photovoltaic field, see the design of the website and the aspects dealing with the guarantee. It is wise to see the exchanges on the forums concerning the manufacturer's brand, are they positive or negative?A guarantee of reliability:

The standards are a guarantee of reliability for photovoltaic solar modules, so installers and manufacturers are able to provide you with quality certificates for the solar panels they offer. There is also the possibility to download the certificates and test certificates directly from the manufacturer's website, for example the certificates for the manufacturer Qcells.

The TUV certificate ensures that the photovoltaic module has passed the rigorous tests carried out by the German TUV (Technischer Überwachungsverien) laboratory proving its resistance to extreme temperatures, accelerated ageing cycles, violent projections and fire.he quality of photovoltaic solar panels:

The quality of the photovoltaic solar panels is an important factor to consider for any rooftop or ground-mounted solar power plant project. Indeed, the quality of the chosen photovoltaic modules will determine the payback time of your solar power plant by guaranteeing you an optimum production of solar energy in the long term.

# Standards

List of standards

The manufacture of photovoltaic modules is governed by several standards.required by the IEC (International Electrotechnical Commission) in order to be sold on the international market.

These standards are as follows:

The IEC 61215 (crystalline) or IEC 61646 (thin film) standard certifies a guarantee of quality in terms of compliance with electrical parameters and mechanical stability. The requirements of this standard refer to the design qualification and approval of photovoltaic modules for terrestrial application and long-term use.

The IEC 61730 standard specifically deals with the prevention of electric shocks, the risk of fire, and the use of the photovoltaic modules in the field of photovoltaic systems and personal injury accidents due to mechanical and environmental stress.

This standard, which deals specifically with the safety aspects of the modules, complements IEC 61215, which sets the electrical performance.

# DEFINITIONS

*Suggested text:* The definitions of terms used in this IALA Guideline can be found in the International Dictionary of Marine Aids to Navigation (IALA Dictionary) at <http://www.iala-aism.org/wiki/dictionary> and were checked as correct at the time of going to print. Where conflict arises, the IALA Dictionary should be considered as the authoritative source of definitions used in IALA documents.

# ACRONYMS

IMO International Maritime Organization (Acronym style)

# REFERENCES

1. Abcd
2. Efgh

# documentation

## proofs

## references

## datasheet

Body text (To assist in the use of this guideline, the following acronyms and definitions have been used:)

## (Example Heading level 2)

Body text

## (Example Heading level 2)

Body text

# AIMS AND OBJECTIVES (Example Heading level 1)

Body text (left justified)

Body text (left justified)

1. List 1.
2. List1.

List 1 text (for subsequent text at the same level).

1. List 1:
   1. List a.
   2. List a.

List a text (for subsequent text at the same level).

* 1. List a:
     1. List i.

List I text (for subsequent text at the same level).

* Bullet 1;

Bullet 1 text (for subsequent text for the same bullet).

* Bullet 1:
* Bullet 2;

Bullet 2 text (for subsequent text for the same level).

* Bullet 2:
* Bullet 3;

Bullet 3 text (for subsequent text for the same level)

* Bullet 3.

# Example Heading level 1

Body text

## (Example Heading level 2)

Body text

1. Geographical range

Where:

*Rg* is the geographical range (nautical miles) (alternatively NM)

*ho* is the elevation of observer’s eye (metres) (alternatively m)

*Hm* is the elevation of the mark (metres) (alternatively m)

### (Example heading level 3)

Body text.

1. Theory of Special Relativity

Where:

*E* is the kinetic energy (Joules) (alternatively J)

*m* is the mass (kilograms) (alternatively Kg)

*c* is the speed of light (metres/second) (alternatively m/s)

#### (Example heading level 4)

Body text.

# Example Heading level 1[[1]](#footnote-1)

Body text. Bullets have only one sentence. Anything further needs to appear in the relevant 'bullet text' style.

* Bullet 1:
* Bullet 1:
* Bullet 1.

## TABLES

Body text

1. Example of a table caption; table with the significant information in the first column

|  |  |
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| Table heading | Table text |
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1. Example of a table caption; table with the significant information in the first row[[2]](#footnote-2)

|  |  |  |
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| **Table heading** | Table heading | Table heading |
| Table text | 1. Table List 11    1. Table list a   Table list i | Table text |
| Table text | Table text | Table text |
| Table text | Table text | Table text |
| Table text | Table text | Table text |

Example of ‘normal text’ following a Table

1. Example of a table caption; table with coloured rows

|  |  |  |
| --- | --- | --- |
| Table heading | Table heading | Table heading |
| Table text | Table text | Table text |
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| Table text | Table text | Table text |

**Note:** Colours for text and cell shading need to be selected from the permitted palette (see ANNEX C)

# FIGURES



1. Example figure caption



1. Another example figure caption

# DEFINITIONS

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# ACRONYMS

IMO International Maritime Organization (Acronym style)

# REFERENCES

1. Abcd
2. Efgh
4. EXAMPLE OF AN ANNEX - LANDSCAPE

Body text

1. example of ANNEX heading level 1

Body text

* 1. example of annex heading level 2

Body text

* + 1. Example of annex heading level 3

Body text

* + - 1. Example of Annex heading level 4

Body text

1. Example table caption

| No | Title/Topic | IMO References | Requirements | Possible Audit Questions | Remarks |
| --- | --- | --- | --- | --- | --- |
| 1 | Table text | Table text | Table text | Table text | Table text |
| Table text | Table text |
| Table text | Table text |

1. EXAMPLE OF AN APPENDIX TITLE
2. APPENDIX HEADING 1

Body text

* 1. APPENDIX HEADING 2

Body text

* + 1. APPENDIX HEADING 3

Body text

* + - 1. Appendix Heading 4

Body text

1. (EXAMPLE ANNEX TITLE)
2. Introduction (Example Annex Heading 1)

Body text.

* 1. Example of ANNEX HEADING Level 2

Body text

* + 1. Example of annex heading level 3

Body text

* + - 1. Example of Annex heading level 4

Body text

1. PERMITTED COLOUR PALETTE

The IALA colour palette is divided in 3 palettes of different level of hierarchy that has to be respected.

Corporate colours (Not shown)

IALA’s corporate colour palette is directly inspired from the colours in our logotype:

* dark blue
* white
* yellow
* gradient blue

Primary & secondary colours

The primary colours are to be applied in complement with the corporate colours.

This second level of colours gives rhythm and helps to segment our publications.

The secondary colours are used to highlight information, titles in a minor proportion only.

These colours can’t be replaced by other tints.

**PANTONE PROCESS CYAN C CMYK :** C 100

**RGB :** R 0 - G 159 - B 223

**CMYK : 50 % OF THE TONE RGB :** R 131 - G 208 - B 245

**CMYK : 50 % OF THE TONE RGB :** R 148 - G 217 - B 213

**CMYK : 50 % OF THE TONE RGB :** R171 - G 219 - B 233

**CMYK : 50 % OF THE TONE RGB :** R 178 - G 193 - B 237

**PANTONE 326C CMYK :** C 81 - Y 39

**RGB :** R 0 - G 175 - B 170

**PANTONE 7703 C**

**CMYK :** C 79 - M 2 - Y 10 - K 11

**RGB :** R 0 - G 181 - B 208

**PANTONE 660 C CMYK :** C 88 - M 50

**RGB :** R 64 - G 126 - B 201

**CMYK : 20 % OF THE TONE RGB :** R 212 - G 237 - B 252

**CMYK : 20 % OF THE TONE RGB :** R 213 - G 240 - B 237

**CMYK : 20 % OF THE TONE RGB :** R 216 - G238 - B 245

**CMYK : 20 % OF THE TONE RGB :** R 218 - G 223 - B 246

**PANTONE 258 C CMYK :** C 51 - M 79

**RGB :** R 153 - G 80 - B 159

**CMYK : 50 % OF THE TONE RGB :** R 201 - G 169 - B 208

**CMYK : 50 % OF THE TONE RGB :** R 183 - G214 - B 155

**CMYK : 50 % OF THE TONE RGB :** R 246 - G 174- B 135

**CMYK : 50 % OF THE TONE RGB :** R 157 - G 157 - B 156

**PANTONE 739 C**

**CMYK :** C 78- Y 95- K 5

**RGB :** R82 - G 174 - B 50

**PANTONE 2347 C**

**CMYK :**M 88 - Y 100

**RGB :** R 230 - G 56 - B 17

**PANTONE COOL GRAY 11 C CMYK :** K 100

**RGB :** R 87 - G 87 - B 86

**CMYK : 20 % OF THE TONE RGB :** R 232 - G 221 - B 288

**CMYK : 20 % OF THE TONE RGB :** R226 - G 238 - B 217

**CMYK : 20 % OF THE TONE RGB :** R 253 - G 224- B 208

**CMYK : 20 % OF THE TONE RGB :** R218 - G 218 - B 218

**CMYK : 10 % OF THE TONE RGB :** R 237 - G 237 - B 237

Guideline

Recommendation

Model Course

PRIMARY COLOURS

SECONDARY COLOURS

1. Example footnote [↑](#footnote-ref-1)
2. Example of footnote [↑](#footnote-ref-2)