|  |
| --- |
| IALA Guideline |

1???

identifying buoy characteristics to meet navigational and operational requirements

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.

|  |  |  |
| --- | --- | --- |
| Date | Page / Section Revised | Requirement for Revision |
| month/year approved by Council | aaaaa | aaaaaa |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

1 INTRODUCTION 10

2 SCOPE 10

3 Navigational requirements and considerations 10

3.1 Purpose or reason for the buoy 10

3.2 Competent authority evaluation 10

3.3 Evaluation of existing system of AtoN within the area of interest 11

3.4 Features of the buoy as an AtoN 11

3.4.1 Additional features to be considered 11

3.5 Approval to Deploy 11

3.6 Buoy owner responsibilities 11

4 Buoy Characteristics (include a basic buoy drawing id major parts)[Rob Dale] 12

4.1 Definitions required refer to IALA Dictionary- 12

4.2 Topics covered in this section:- 12

4.3 General construction materials ? 13

4.4 Top Mark 13

4.5 Aerials 15

4.6 Radar reflectors 15

4.7 Lanterns 16

4.8 Radar Beacons (Racons) 18

4.9 Audible signals 18

4.10 Names/numbers for identification 19

4.11 Solar panels 19

4.12 Control equipment/ leads and plugs? 19

4.13 Super structure 20

4.14 Bat wings 20

4.15 Batteries 21

4.16 Lifting lugs 22

4.17 Colours/colour breaks 22

4.18 Anodes 22

4.19 Mooring points 22

4.20 Weights 22

4.21 Tail tube/skirt 22

4.22 Bridle 22

4.23 Mooring chain/rope/shackles 22

4.24 Sinker 22

4.25 Additional equipment, cameras/sensors (hydro sensing) monitoring and telemetry, comms, future proofing (MASS), AIS 23

5 Physical Environment / Environmental Considerations [Jorg Unterderweide / Tiit Palgi] 25

6 Buoy Types and Variations [Richard Vermeer & Marco Krings] 26

7 Resource Considerations [Peter Dobson/ Gillian Burns] 30

7.1 Lifetime cost of the buoy 30

7.1.1 How long is a lifetime? 31

7.1.2 Decommissioning plan 31

7.1.3 End of life disposal 31

7.2 Consent and licencing 31

7.3 Funding 31

7.3.1 How is this to be achieved? 31

7.3.2 Where does the funding come from? 31

7.4 Navigational performance 32

7.4.1 Inspections 32

7.4.2 Availability 32

7.4.3 Monitoring – (SEE SECTION 7.9 AS POSSIBLE DUPLICATION – This section may not be needed?????) 32

7.4.4 User reporting 32

7.5 Stakeholder information 32

7.5.1 Navigational warnings 33

7.5.2 Notice to mariners 33

7.6 Environment 33

7.6.1 Considerations for protected areas 33

7.6.2 Plastics and micro-plastics 33

7.6.3 Marine growth 33

7.6.4 Invasive species 33

7.6.5 Use of antifouling 34

7.6.6 Anodes 34

7.6.7 Operational area 34

7.6.8 Aerial (Aero?) contamination 34

7.7 People 34

7.7.1 Vessel based operations 34

7.7.2 Shore based operations 34

7.8 Equipment 35

7.8.1 Shore based infrastructure 35

7.8.2 Vessels 35

7.9 Maintenance 36

7.9.1 Failure measures 36

7.9.2 Inspection 36

7.9.3 Frequency of maintenance visits 36

7.9.4 Monitoring of buoys and their associated AtoN 36

7.9.5 Contracting out maintenance 36

7.9.6 Performance measures 36

7.9.7 Maintenance approach 37

7.9.8 Waste disposal 37

7.10 Reliability / redundancy 37

7.10.1 Casualty response 37

7.10.2 Spares 37

7.10.3 Operational environment 38

7.11 Third party equipment 38

8 Additional Considerations 39

8.1 monitoring – [Input Paper from China MSA ENG16] 40

8.1.1 Objective of monitoring 40

8.1.2 Content of monitoring 40

8.1.3 Methods of monitoring 40

9 Lettering [email from Partel 18/10/2022] 41

10 Text below this point is for information and reference only! 41

10.1 Purpose for the buoy 42

10.2 Day ~~visibility~~ - Conspicuity 42

10.2.1 Range 42

10.2.2 Colour 42

10.2.3 Shape/daymark/Topmark 42

10.2.4 L~~ettering~~ – Buoy Identification 42

10.2.5 Position accuracy 42

10.3 Night visibility 42

10.3.1 Retroreflective night marking 42

10.3.2 light 42

10.4 radio recognition 43

10.4.1 AIS 43

10.4.2 RACON 43

10.4.3 Radar reflector/Radar reflection characteristics 43

10.5 audible 43

10.5.1 Fog signal 43

10.5.2 bell 43

10.6 Availability 43

10.6.1 position accuracy 43

10.6.2 technical availability 43

10.7 Complementary Use 43

11 How is the Navigational requirement achieved 43

11.1 Shape 43

11.2 Day visibility 44

11.3 Colours 44

11.4 Lettering 44

11.5 Topmark (Daymark) 44

11.6 Retroreflective Material 44

11.7 Night visibility 44

11.8 Range of light 44

11.9 Light Characteristic 44

11.10 Sound Signals 44

11.11 Radar Reflectors 44

11.12 Racons 45

11.13 Automatic Identification System (AIS) 45

11.14 Position 45

12 Supporting Equipment 45

12.1 Availability 45

12.2 monitoring 45

12.3 Moorings 45

12.4 Power systems 45

12.5 Buoy body performance 45

12.6 Complimentary Fit 46

13 Monitoring 46

14 site conditions based on the geographical position 46

14.1 The geographical position of the buoy gives the site conditions, who are:   46

15 Additional technical information/specification 47

16 Buoy behavior 48

17 evaluation of the buoy CHARACTERISTICS 49

17.1 Daymark 49

17.2 Night Visibility 49

17.3 Additional factors 49

17.4 buoy body 49

18 Operational behaviour 51

19 Buoy Selection 51

20 Verification of buoy choice: 52

21 Content from Paper – 2.5.3 52

21.1 (Example Heading level 2) 60

21.2 (Example Heading level 2) 60

22 AIMS AND OBJECTIVES (Example Heading level 1) 60

23 Example Heading level 1 61

23.1 (Example Heading level 2) 62

23.1.1 (Example heading level 3) 62

24 Example Heading level 1 62

24.1 TABLES 62

25 FIGURES 63

26 DEFINITIONS 64

27 ACRONYMS 64

28 REFERENCES 64

ANNEX A EXAMPLE OF AN ANNEX - LANDSCAPE 65

APPENDIX 1 EXAMPLE OF AN APPENDIX TITLE 66

ANNEX B (EXAMPLE ANNEX TITLE) 67

ANNEX C PERMITTED COLOUR PALETTE 68

List of Tables

Table 1 Example of a table with the significant information in the first column 4

Table 2 Example of a table with the significant information in the first row 4

Table 3 Example of a table with coloured rows 4

Table 4 Example table 4

List of Figures

Figure 1 Example figure caption 4

Figure 2 Another example figure caption 4

List of Equations

Equation 1 Geographical range 4

Equation 2 Theory of Special Relativity 4

# INTRODUCTION

Buoys are in use as AtoN since hundreds of years. They have been developed from wooden barrels to high tech steel or plastic buoys with LED-light source, Solar-Power and further electronic equipment like AIS and remote monitoring. Also passive Radar reflectors and/or RACONs can be mounted. The diameter can vary from 0.15m to very large modular buoys with diameters of 4.00m.

Depending from their navigational use and the individual site conditions the design can differ in a wide range. Manufacturers offer a lot of different buoy sizes made of different materials.

So it is not easy to find the right buoy also in combination with operational demands.

# SCOPE

This guideline has been developed to assist aids to navigation (AtoN) manufacturers, Competent Authorities and buoy owners when developing and selecting buoys for different purposes, depending from nautical, geographical and operational requirements.

# Navigational requirements and considerations

The navigational requirements for any new AtoN will be evaluated by the Competent Authority and are directly related to SOLAS V Regulation 13 that states, Aids to Navigation should be provided where practicable and necessary as the volume of traffic justifies and degree of risk requires.

The Competent Authority will undertake a review of the proposed buoy deployment to evaluate its navigational significance and determine the minimum requirements for the specific site.

Documents to be aware of from the outset of this process are noted below and both are available on IALA Website:

* R1001 The IALA MARITIME BUOYAGE SYSTEM (MBS)
* IALA Navguide: Chapter 3 (Marine Aids to Navigation).

The Competent Authority evaluation will consider each of the following topics:

## Purpose or reason for the buoy

The purpose or reason for a buoy deployment should be presented to the Competent Authority in the first instance for appraisal. The Competent Authority will then review the circumstances associated with the deployment and make recommendations. Factors that contribute to this include but not limited to:

* Buoy has been specified as a requirement of a Marine Licence or other project
* required to protect the Mariner/environment from a hazard to navigation
* required to mark the entrance to a channel/ harbour/ marina
* scientific device to evaluate meteorological/ oceanographic conditions or monitor flora/ fauna in the immediate sea area to the buoy
* whether the deployment is temporary or permanent, seasonal

## Competent authority evaluation

The Competent Authority will evaluate the purpose/ reason of the buoy to determine if the proposed buoy mitigates the hazard to navigation, this will include but not limited to :

* assessment of the purpose or reasoning for the buoy
* to determine if the proposed buoy is fit for purpose or if a different AtoN (fixed/virtual) would be more appropriate; consideration of environmental and climatic conditions
* vessel traffic by, density, type and cargo; vessel activity by day/ night and seasonal variations (if a Navigational Risk Assessment, Lighting and Marking Plan, Emergency Response Co-operation Plan or contingency plan have been undertaken these will be reviewed)
* type of feature to be marked (dredged channel or area, obstruction, subsea scientific instrumentation, danger area etc)
* position of hazard in relation to the proposed buoy position
* within a channel/ waterway the number and spacing of buoys must be considered

## Evaluation of existing system of AtoN within the area of interest

The Competent Authority will undertake a desk top review of the existing system of AtoN and local area features to inform the required characteristics of the proposed buoy along with any existing and new hazards (such as a new construction or obstruction), background lighting and other local factors will also be considered.

## Features of the buoy as an AtoN

The buoy will be required to have specific characteristics that conform to IALA recommendations and guidelines and will be determined and specified by the Competent Authority using the following steps:

* whether the buoy is to be Lit or Unlit, will be determined from the vessel traffic evaluation and meteorological conditions
* characteristics (light flash character),
* range of light, colour of light, colour/shape of buoy body,
* focal plane height and synchronisation of/ to any other AtoN within an area, topmark, symbols/ numbering), will be determined from the evaluation of the existing system of AtoN and the purpose of the buoy (refer to IALA MBS; Recommendation R1001 The IALA Maritime Buoyage System)
* additional AtoN requirements, such as AIS AtoN, Racon, sound signal, Radar reflector (active or passive) depend upon the navigational significance of the buoy and/ or meteorological conditions
* buoy (and additional AtoN) availability and reliability are derived from their navigational significance and are measured using IALA Categorisation (1,2 or 3) (refer to IALA Recommendation R0130 Categorisation and Availability Objectives for Short Range Aids to Navigation)

### Additional features to be considered

There may be further additional features that can be fitted to the buoy that increase its conspicuity or reliability these include:

* The use of retroreflective material
* monitoring (position accuracy, light operation battery voltage/ charge, environmental sensors)
* Daytime conspicuity

## Approval to DEPLOY

The Competent Authority may wish to issue an approval to deploy that officially authorises the AtoN and add the buoy to the national list of AtoN once it has been deployed. For buoys that are seasonal or in position for short durations notification can be given by other means, e.g. Notice to Mariners.

## Buoy owner responsibilities

Buoy owners should be aware of their responsibilities, the list below highlights the minimum requirements:

* The deployment should be advertised to the Mariner by means of a Notice to Mariners
* The Notice to Mariners should be copied to the national Hydrographic Office responsible for charting to allow updates to be completed if required
* Throughout the lifetime of the buoy any outages or defects should have a Radio Navigation Warning and / or Notice to Mariners issued to advise the Mariner of the defect, any issued Notice to Mariners should be withdrawn once the buoy is fully operational
* Maintenance of the buoy should be undertaken, any period the buoy is removed from site for this purpose should be covered by a Notice to Mariners
* The buoy may be periodically inspected by the Competent Authority and will be expected to meet the required availability associated with the Category of the buoy and other fitted AtoN

# Buoy Characteristics (include a basic buoy drawing id major parts)[Rob Dale]

## Definitions required refer to IALA Dictionary-

Primary

Supplementary

AtoN

## Topics covered in this section:-

* Topmarks
* Aerials
* Radar reflectors
* Lanterns
* Radar Beacons (Racons)
* Audible signals
* Names/numbers for identification
* Solar panels
* Control equipment/ leads and plugs?
* Super structure
* Batteries
* Lifting lugs
* Colours/colour breaks
* Anodes
* Mooring points
* Weights
* Tail tube/skirt
* Bridle
* Mooring chain/rope/shackles
* Sinker
* Additional equipment??

## General construction materials ?

Steel and plastic both having benefits, give a holistic view of the current market and what’s on offer.

## Top Mark

The use of a topmark is very important to assist the mariner in recognising different types of buoys and identifying their purpose. Generally, they are significantly smaller than a buoy itself and therefore have a reduced visual range. It is important to understand which topmarks are mandated for use on which buoys within the Maritime Buoyage System (MBS) but as a general rule of thumb, all types should be encouraged.

To fulfil its purpose the topmark should be situated at a height clearly above all other parts of the buoy and follow the proportional dimensions as stated within Guideline 1094. It is common for the mariner to first recognise the type of buoy by either its general shape as in case of lateral buoys or its topmark as is the case with cardinal buoys. It should be noted that some topmarks have incorporated within their design a passive radar reflector (See Radar Reflector)

There are numerous construction materials available these range from but are not limited to-

* Medium density polythene
* Glass reinforced plastic (GRP)
* Ferrous and non-ferrous metals
* Marine grade plywood

Diagram

Description automatically generated

*Fig 1. Topmark proportions*

It is recommended that topmark dimensions are proportionate to the waterline diameter of the buoy body. This dimension is referred to as X in the guideline and it recommends that X measures 15-25% of the waterline diameter of the buoy.

A picture containing text, water, red

Description automatically generated

*Ref. (IALA Guideline 1094 Daymarks for AtoN ) (MBS)*

## Aerials

The use of aerials and their purpose will solely depend upon what electronic aids are fitted to compliment the general purpose and function of a buoy. Typical GPS and AIS systems will require some means of receiving and transmitting data and consideration should be made when using two or more aerials to ensure performance is not impacted by Radio Frequency Interference (RFI). The physical position of any aerial(s) should not inhibit detection of or recognition or identification of a buoy during daylight or night-time. Also placement on the buoy should ideally be within the physical envelope of the buoy structure rather than

## Radar reflectors

Buoys generally constitute poor radar reflecting targets and therefore to enhance their detection the fitment of a radar reflector can improve target detection. This supplementary AtoN device enhances radar cross section (RCS) at longer ranges but offers improved protection against damage by collision.

Reflectors are typically passive (non-powered) and their performance is determined by 4 factors:-

* The type of reflector
* Its size
* Height above water level
* Stability of reflector

Active reflectors are commonly called Radar Target Enhancers (RTE), although requiring some form of energy supply these can improve detection by 5-10 times that of passive reflectors and are capable of working with 3 & 9 GHz radars.

A picture containing text, ground, accessory, umbrella

Description automatically generated

Fig 2 Passive 10-corner cluster reflectors (manufactured in aluminium)

A picture containing text

Description automatically generated

Fig XX an active RTE

## Lanterns

The primary purpose of a lantern is to assist in the detection and identification of a Buoy during periods of darkness or poor visibility. Lanterns are commercially available in two main variants of which almost all use Light Emitting Diode (LED) technology.

* Self-contained
* Stand alone or Integrated Power System Lanterns

As detailed in the MBS there are 5 colours used:-

* Red
* Green
* Yellow
* White
* Yellow/Blue

Lantern range or simply put how far the light can be seen by the mariner is traditionally classified in Nautical Miles (NM). The more scientific method for measuring light is illuminance intensity, this is expressed in Candela (cd). The following table shows the relationship between the units, typically the navigational requirement will be set as NM.

Table

Description automatically generated

Lanterns are not only used to indicate buoy position but by means of the flashing sequence or pattern, they switch on and off they notify the mariner of the buoy type and warn of potential hazards. A buoy lantern`s flash character and colour combined when conforming to IALA guildline xxxx can assist the Marnier in determining what type of buoy is in position and what if any action they need to take or be aware of.

As lanterns become more technologically complex the array of augmented features is ever expanding, from in-built monitoring and communication to remote changing of flash character the suite of features that are available can at times be quite intimidating. Yet despite these additional attributes, the basics remain the same…range/colour/character.

## Radar Beacons (Racons)



**Fig xx a typical Racon**

Radar Beacons or Racons are powered devices installed on a buoy that provide an electronic return to a ship’s radar that help to locate and/or identify a navigation mark. When responding to a ship`s radar they return a characteristic pulse train that appears as a coded mark on the ships radar display screen. They are considered a supplementary AtoN and are typically used in the marking of fairways, turning points in traffic separation schemes and hazards. As racons are frequency agile they are able to provide a return response that matches both types of ships radars.

There are two types of ship`s radars:-

* S band High frequency/short range (9GHz)
* X band Low frequency/long range (3GHz)

All ships over 300GT and above must carry a 3GHz (x band) radar whilst all ships over 3000GT must carry a 9GHz (s band) radar or where appropriate a second 9GHz radar.

Due to their relative cost and degree of technical expertise required to maintain them careful consideration should be taken before mandating their use.

See IALA Recommendation R0101 Marine Radar Beacons (Racons) and Guideline G1010 Racon Range Performance for more information.

## Audible signals

Audible signals are occasionally fitted to buoys to enhance their awareness to the Mariner during periods of poor visibility. Such conditions can include fog, heavy rain, snow, sand storms and smoke. Typical signals such as bells, gongs and whistles that are wave motion activated or powered horns can be used with ranges from 0.25-0.5 NM.

Audible signals on buoys should be used to warn mariners of a particular hazard, such as proximity to shoals, rocks or other hazards; or to alert the mariner to a change in navigational requirements, such as the entrance to a restricted channel.

IALA Guideline G1090 The Use of Audible Signals should be used as a reference for this topic.

## Names/numbers for identification

Buoys are often identified by names, abbreviations of names, letters and/or numbers. It is important that the actual marking on the buoy is identical to the List of Lights reference and the charted marking. Whilst there is no specific requirement for the placement and size of text, consideration should be given so that it is prominent and easily identifiable.

Lateral marks are sometimes numbered from the seaward side with even numbers used for red buoys and odd numbers for green.

In addition to the placement of names and numbers to support identification, retroreflecting materials can also be used. This type of material bounces light back along its original path and is recommended for buoys at are unlit and where identification is difficult at night.

IALA Recommendation R0106 (E-106) Retroreflecting Material on Aids to Navigation Marks within the IALA Buoyage System

## Solar panels

A majority of buoys in service use solar (photovoltaic process) energy as a primary source of power. Physical size, numbers used and even colour of the panel(s) required will be determined by the demand to keep the electrical systems operational. Typically built from monocrystalline silicone they should be manufactured to withstand harsh environmental conditions and if possible positioned in locations less susceptible to damage. Guideline 1067 electrical loads of AtoN

A picture containing appliance, kitchen appliance

Description automatically generated A picture containing text

Description automatically generated

## Control equipment/ leads and plugs?

Any electrical control equipment mounted within or on a buoy structure, should have a design life that exceeds the life expectancy of the buoy. In essence, equipment fitted should not be the determining factor for the buoy to be withdrawn from service and then repaired or replaced. The selection of good quality proven products and materials is paramount to ensure longevity of the equipment and is control cable materials and plugs. Designs should, where possible only have bottom entry cable runs in and out of cubicles and consider mounting external indicators or safety disconnection devices in easy to access prominent positions.

Text

Description automatically generated

Electrical cubicle with side only cable entry

Types of materials and plug types??

## Super structure

The buoy super structure is essentially a construction placed upon the buoy hull that provides an elevated position for housing a lantern, top mark and any augmented equipment (such as aerials and radar reflectors etc). The materials used will generally be those that can withstand significant and prolonged exposure to the elements. As the super structure forms a significant proportion of the total daytime conspicuity of a buoy consideration must be given to its size and density to be seen from a relative distance. Traditional super structures were lattice style towers designed to be inherently strong yet allow wind to blow through thus having a reduced impact upon buoy stability.

A picture containing building, tower, pylon

Description automatically generated A picture containing sky, outdoor, ocean

Description automatically generated

## Bat wings

Bat wings are an industry term for additional materials fixed to a buoy super structure that can serve a number of different purposes dependent upon its design. The two examples below are good illustrations.

Pic 1 shows the use of bat wings to enhance the daytime conspicuity and provides a suitable area for station identification/name. In this example, the wings were manufactured from a flexible coloured rubberised product that bends to allow for windage.

Pic 2 depicts the use of batwings to form the required shape of the daymark to conform to the MBS. This material is rigid but has machined slots to overcome the effect of strong wind on the buoy`s overall performance and stability.

A picture containing text, transport

Description automatically generated A picture containing text

Description automatically generated

Pic 1 Pic. 2

## Batteries

Contained within every lighted buoys electrical system will be a battery in some capacity. A batteries basic function is to safely store generated electrical energy and dispense it in a controlled manner when required. There are a number of different battery types available each with their own individual performance benefits and constraints along with cost. For buoy systems, the most popular variant is the Lead Acid Gel (value regulated) 12-volt model predominantly due to its availability, low cost and proven reliability.

Diagram, engineering drawing

Description automatically generated

## Lifting eyes

A majority of buoys used in service will require some form of lifting operations undertaken for positioning or transportation. In order for this function to be undertaken safely, consideration within their designs should make suitable allowances for this. Typically, lifting points should be arranged in prominent easily accessible positions to allow for ease of use.

A fundamental aspect of any lifting point(s) is it must provide a suitable and safe anchor point to lift the entire buoy weight. It is usual for these points to be manufactured with a safety factor of at least 100% and is normally expressed as a ratio; this ensures the identified points are capable of lifting more than twice (or more) the whole structure`s weight. Given the environment buoys operate within and the potential for structural damage, it is critically important these points are inspected and tested regularly as soon as reasonably practical. Buoy manufacturers should provide suitable recommendations for lifting arrangements, indicating the configuration and equipment to be used. Additionally when new, a test certificate indicating the lifting points have been functionally tested to their indicated design parameters should be supplied.

## Colours/colour breaks

To ensure compliance to the Maritime Buoyage System (MBS) every deployed buoy should follow the recognised colours and colour combinations as illustrated within the MBS. This is vitality important for daytime identification of all types of marks.

## Anodes

Sacrificial anodes, why have then? What do they do, change out frequency? Size? materials

Prevents galvanic corrosion, material nobility, generally come in three metals - aluminium, magnesium and zinc

## Mooring points

Size, material? Change out if sacrificial inserts? Repair of

## Weights

Ballast weights, use of, why do you need them? Change out and swap number/size

## Tail tube/skirt

## Bridle

To include swivels or “monkey face”

## Mooring chain/rope/shackles

Size, types, materials,

## Sinker

Why have different sizes, sub surface conditions (sanding), materials and types.

## Additional equipment, cameras/sensors (hydro sensing) monitoring and telemetry, comms, future proofing (MASS), AIS

Diagram

Description automatically generated

Diagram

Description automatically generated

A picture containing water, outdoor, sky, boat

Description automatically generated A red and white oil rig in the middle of the ocean

Description automatically generated with low confidence A picture containing indoor

Description automatically generatedDiagram

Description automatically generated

# Physical Environment / Environmental Considerations [Jorg Unterderweide / Tiit Palgi]

Overview for each bullet point and add relevant IALA GL reference number for further reading (use Technical Documents Catalogue)

* Other sources of lights (ports/harbours etc) / backlighting  
  Background lighting or rival lights could affect the visible range and impact the conspicuity of the AtoN light if they are sufficiently intense (see [1148 Ed.1 Guideline G1148 on determination of required luminous intensity for marine signal lights](https://www.iala-aism.org/repository/guidelines/1148%20Ed.1%20Guideline%20G1148%20on%20determination%20of%20required%20luminous%20intensity%20for%20marine%20signal%20lights.pdf)). In case of significant background lighting, consideration should be given to the possible need for AtoN lights to switch on earlier than the background lights ([1038 Ed3 Methods and Ambient Light Levels for the Activation of AtoN lights December 2016](https://www.iala-aism.org/repository/guidelines/1038%20Ed3%20Methods%20and%20Ambient%20Light%20Levels%20for%20the%20Activation%20of%20AtoN%20lights_December%202016.pdf))
* Flora/fauna : (seaweed growth – on buoy/ chain and in the surrounding water)  
  At Marine protected Areas or sites where damage to flora and fauna on the seabed is of concern the mooring may have to be designed adequately (see [1066 Ed.1.1 The Design of Floating Aid to Navigation Moorings June2010](https://www.iala-aism.org/repository/guidelines/1066%20Ed.1.1%20The%20Design%20of%20Floating%20Aid%20to%20Navigation%20Moorings_June2010.pdf)). Further general information on reducing environmental impact of AtoN can be found at [1137 Ed.1 AtoN Management in protected areas Dec2017](https://www.iala-aism.org/repository/guidelines/1137%20Ed.1%20AtoN%20Management%20in%20protected%20areas_Dec2017.pdf) and [1036 Ed3 on Environmental Management in Aids to Navigation June 2017](https://www.iala-aism.org/repository/guidelines/1036%20Ed3%20on%20Environmental%20Management%20in%20Aids%20to%20Navigation_June%202017.pdf). Some climates promote high vegetation cover and growth. The need to constantly control and clear excessive vegetation can be an issue to maintain operation of an AtoN in these regions.
* bird/ mammal fouling on buoy  
  Bird fouling can obscure the colour of a daymark and prevent identification. It can also cover solar panels, where an sufficient angle of inclination could promotes self‐cleaning ([1039 Ed.2 Designing Solar Power Systems for Aids to Navigation Dec2017](https://www.iala-aism.org/repository/guidelines/1039%20Ed.2%20Designing%20Solar%20Power%20Systems%20for%20Aids%20to%20Navigation_Dec2017.pdf)). The corrosive effects of bird fouling can cause damage leading to reduced life or premature failure ([1094 Ed2 Daymarks for Aids to Navigation June 2016](https://www.iala-aism.org/repository/guidelines/1094%20Ed2%20Daymarks%20for%20Aids%20to%20Navigation_June%202016.pdf)). Dried fouling is very difficult to remove and heavy fouling should not be allowed to dry on the buoy ([1077 Ed.1 Maintenance of Aids to Navigation Dec2009](https://www.iala-aism.org/repository/guidelines/1077%20Ed.1%20Maintenance%20of%20Aids%20to%20Navigation_Dec2009.pdf)). Slippery types of coating will make the removal of any marine fouling considerably easier ([1015 Ed2.1 Painting Aids to Navigation Buoys Dec2013](https://www.iala-aism.org/repository/guidelines/1015%20Ed2.1%20Painting%20Aids%20to%20Navigation%20Buoys_Dec2013.pdf)).
* Marine Protected Area/ Sensitive Sea Areas (poss move to Specifications area) 🡪 see Flora/faune
* Tide

Tides are affecting floating AtoN’s as well as fixed AtoN’s. In case of tides floating AtoN’s may be affected by tidal flow (see currents) and changing water depth (see Depth of water). For instance in case of high tide, the float of the buoy must be designed to support the weight of the whole mooring chain length. Both effects (tidal flow and changing water depth) should be considered when selecting feature to be marked or selecting floating AtoN type. In some cases AtoN’s can be used only on time of high tide and on low tide time the AtoN could lie on seabed (drying stations). To prevent damages and ensure service of the floating AtoN’s, special designs (like skirt buoys) should be used. The mooring system of the floating AtoN’s should be designed taking into account considerations made at IALA Guideline 1066 On the Design of Floating Aid to Navigation Moorings. Fixed AtoN’s must be designed to give nautical information up to the highest sea level.

* Current

In case of currents the water is flowing in one direction similarly to the rivers. In case of tides and wind induced currents the direction of water flow is changing. In some cases (like at sea near rivers) the water flow is constantly in one direction. In these situations floating AtoN’s will tilt downstream. In some cases (tidal flows) mariners may use that to assess flow direction. If LED lanterns are used on these situations care should be taken to make sure that lantern’s vertical divergence is suitable to be seen by mariners. Additional considerations should be made when selecting the method for anchoring floating AtoN (additional information see Guideline 1066 On the Design of Floating Aid to Navigation Moorings and IALA Guideline G1165 Sustainable Structural Design of Marine Aids to Navigation paragraph 6.2.11. CURRENT/FLOW/IMPACT)

* Depth of water

Water depth affects selection type of AtoN as well as selection of mooring for floating AtoN. In case of fixed AtoN’s the coloring scheme is changing according to the water level. At splash zone area flora and fauna will start to grow. Placeing floating AtoN to the shallow water area, care should be taken to prevent AtoN hiting sea bottom or mooring system which leads quickly to the failure of the AtoN. Shallow water conditions induce additional risks for buoy tenders. In case of deep water the weight of the mooring line should be taken into considerations (additional information see Guideline 1066 On the Design of Floating Aid to Navigation Moorings and IALA Guideline G1165 Sustainable Structural Design of Marine Aids to Navigation paragraph 6.2.10. HYDROSTATIC)

* wave conditions  
  [1099 Ed1 The hydrostatic design of buoys May 2013](https://www.iala-aism.org/repository/guidelines/1099%20Ed1%20The%20hydrostatic%20design%20of%20buoys%20May%202013.pdf) provides information on those aspects of buoy design that effect the buoyancy and stability of the buoy. The [Guideline 1066 On the Design of Floating Aid to Navigation Moorings](https://www.iala-aism.org/repository/guidelines/1066%20Ed.1.1%20The%20Design%20of%20Floating%20Aid%20to%20Navigation%20Moorings_June2010.pdf) should be consulted when loads due to wind and tidal effects are being considered
* weather conditions (various temperatures ice/sun) – extremes of temperature
* Ice  
  To withstand these conditions, the buoy hull material must be sufficiently robust and its shape must be constructed accordingly (see [1108 Ed.1 Providing AtoN services in Polar Regions Dec2013](https://www.iala-aism.org/repository/guidelines/1108%20Ed.1%20Providing%20AtoN%20services%20in%20Polar%20Regions_Dec2013%20%20(003).pdf) and [1006 Ed. 4 Plastic Buoys Dec 2018](https://www.iala-aism.org/repository/guidelines/1006%20Ed.%204%20Plastic%20Buoys_Dec%202018.pdf))
* seabed conditions
* Traffic density – have a think GMB

# Buoy Types and Variations [Richard Vermeer & Marco Krings]

Overview for each bullet point and add relevant IALA GL reference number for further reading (use Technical Documents Catalogue)

Name different types of buoys for different applications:-

* *Spar*
* *Mooring*
* *Drying stations*
* *Fast currents – catamaran hull type etc*
* *Large buoys*
* *Data/scientific equipment buoys*
* *Resting/beach buoys – safety feature for swimmers (yellow raft)*
* *International border buoys – Special mark*
* *Safety net buoys (buoys with strong rope between them)*
* *Recreation markers – race markers, kite surfing, speed boats*
* *Buoy structure – considerations for ice buoy (photo of ice buoy)*
* *Look at plastic guideline for photos*

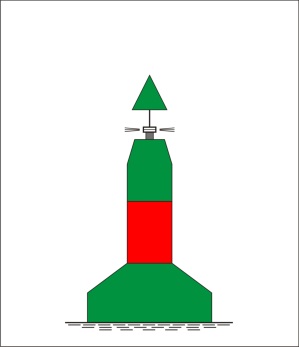
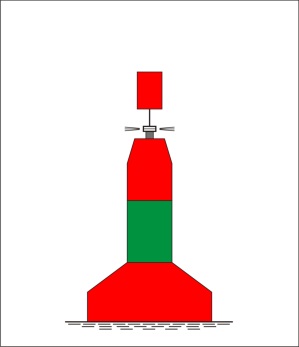
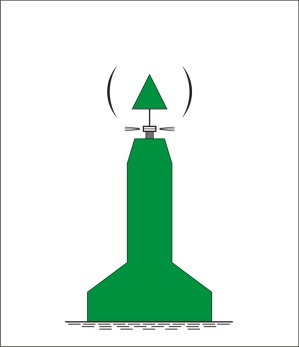
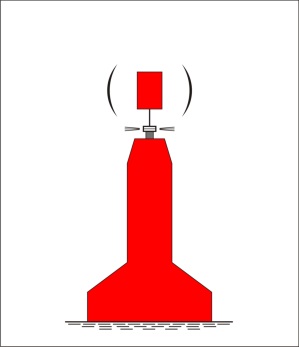
Overview of typical buoy types

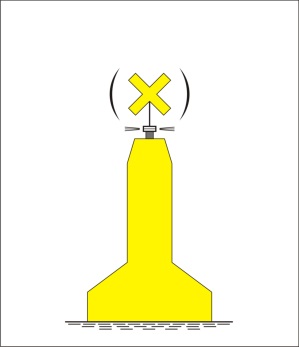
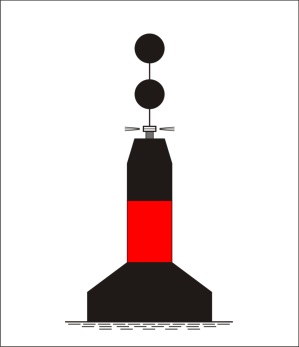
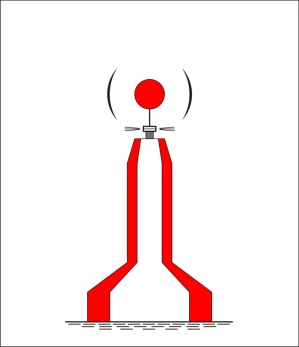
Those for types are the mostly used buoys for offshore and estuaries. The pictograms show the basic structure of the buoy above the waterline.

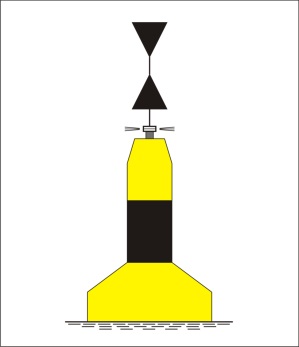
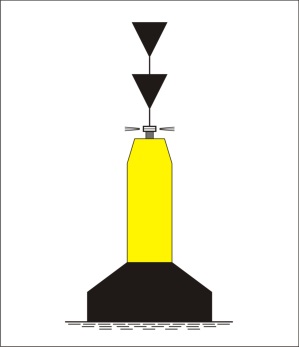
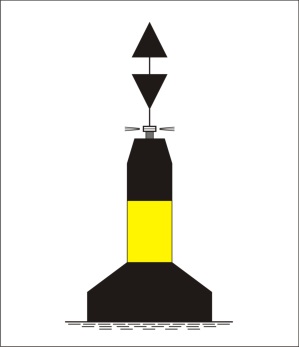
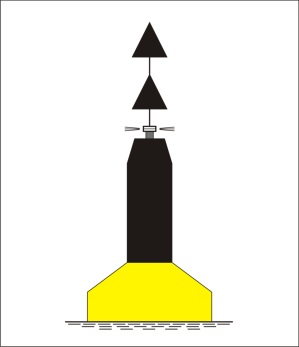
The different types can be used in different size classes depending on the area of application.

* Light buoy (Pillar Buoy)

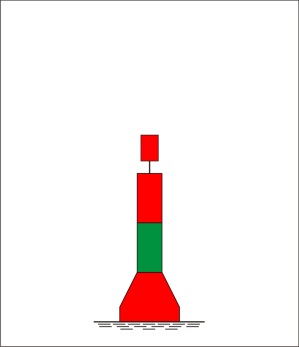
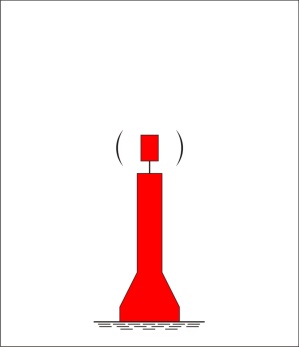
(Include image description including Sys A lateral details)

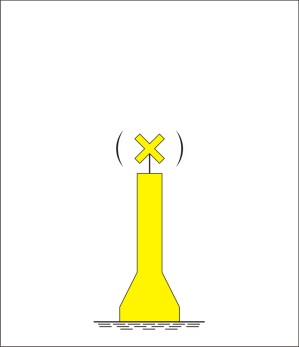
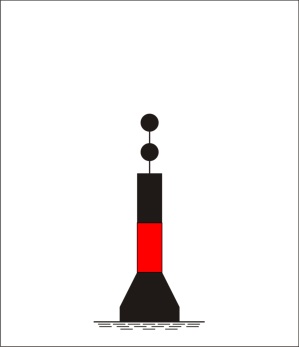
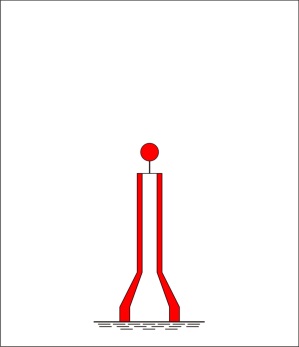


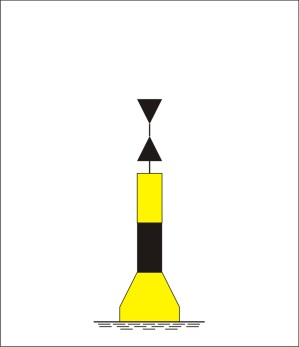
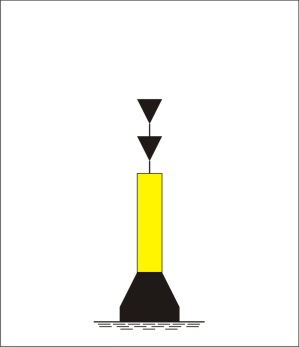
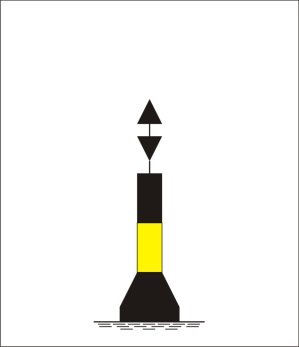
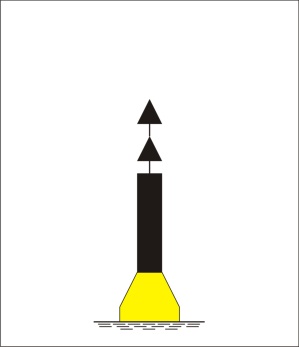




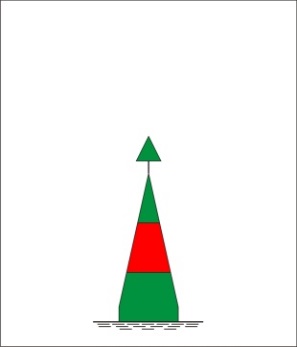
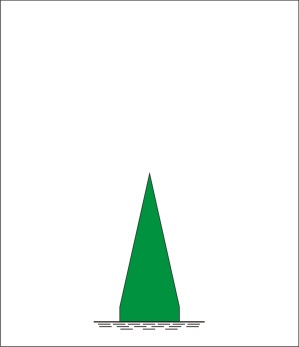
* Spar buoy cylindric

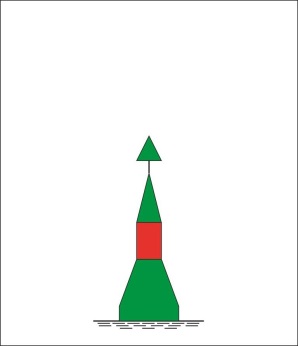
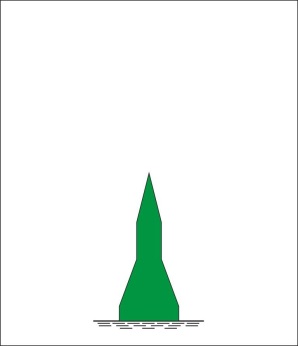




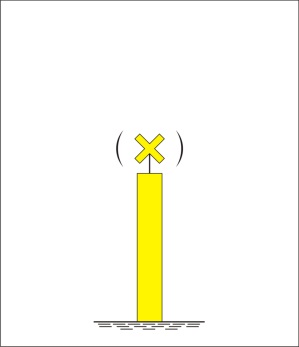
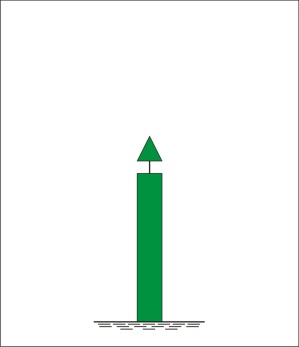
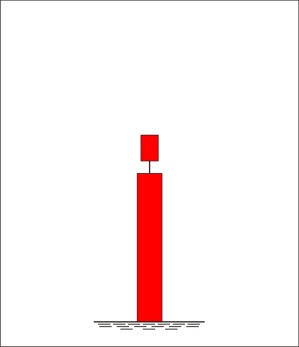


* Spar buoy conical





* Spar



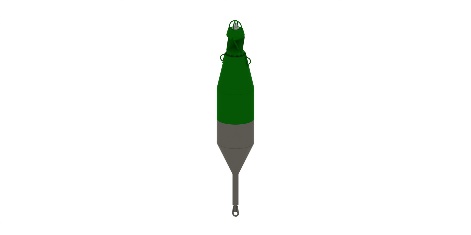
Perhaps here we could show some examples for buoys for rivers (smaller, fast current, …)

We should look for examples.

Admiralty buoy / barrel buoy (different classes/ sizes)

A picture containing icon

Description automatically generated A picture containing sky, outdoor, water, yellow

Description automatically generated A red and white structure in the water

Description automatically generated with low confidence

A picture containing transport

Description automatically generated A picture containing yellow, transport

Description automatically generated A picture containing logo

Description automatically generated

# Resource Considerations [Peter Dobson/ Gillian Burns]

At the earliest stages in the consideration and selection of a buoy for any given requirement, there are a number of wider aspects relating to the ongoing resourcing needed for the ownership, operation and subsequent disposal of such assets through their life. This section discusses some of these key demands.

## Lifetime cost of the buoy

The lifetime costs of a floating AtoN should be considered during the initial design or selection of the buoy to ensure the correct resources can be assessed and assigned. This will allow for an informed selection of the various technical design specifications and financial budgeting over the expected lifetime of the AtoN. There are many resource considerations over the expected lifetime of a buoy depending on its purpose, location and navigational significance; considerations may include:

### How long is a lifetime?

How long a buoy is to be deployed will directly impact on the financial costs associated and infrastructure resources needed, things to consider are:

* Is the buoy is temporary or permanent;
* Is the buoy seasonal and reused every year and what time of year is the deployment;
* Hire in or purchase for a new location;
* Servicing / refurbishing periodicity.

### Decommissioning plan

Consideration should be given to the resources needed to achieve the decommissioning plan during the initial proposal stage of a buoy deployment. This is especially true for a temporary buoy. This will allow financial and environmental planning to be undertaken and understood and hence the resources necessary by the buoy owner. The plan could include disposal options or reuse/ recycling of each buoy component depending on wear and local recycling facilities.

### End of life disposal

The cost associated with end of life should be factored in at initial design to ensure that when the buoy is no longer required or has reached the end of its operational life it can be disposed of in a sympathetic way, where possible recycling or reuse should be considered.

## Consent and licencing

The resource both financial and staff should be accounted for to ensure the amount of time it may take to obtain the required permissions and approvals at both the installation and decommissioning phases of the buoy’s life, these will depend upon National requirements; contacting the Competent Authority to ask for guidance will assist with understanding the process.

## Funding

Resource in the form of funding and how this is to be obtained, should be considered for the expected lifetime of the buoy’s deployment, maintenance and any subsequent replacements costs must be factored in during initial planning and design.

### How is this to be achieved?

The type and purpose of the buoy will likely determine the method of funding, it is possible that some deployments are part of a project and may be financed from sponsorship or grant funding for research and development. Otherwise, an uplift in revenue finding will be needed.

### Where does the funding come from?

How the additional funding is to be generated may require some form of cost benefit and approval. Such funding may be in the form of direct capital funding with maintenance cost provision built into future budgeting arrangements or may be an uplift in revenue costs. These arrangements will likely include the following:

* Initial costs; design, planning, licensing (if required), purchase and deployment of buoy system.
* Ongoing operational costs; maintenance, refurbishment and casualty responses.
* Increase in spares holding.
* Decommissioning costs; removal of all components of the buoy system from the marine environment including recycling and/ or disposal.

The sourcing of such funding will be different for each organisation, but it may be privately sourced, through government general taxation or via light dues. Regardless of the source, this may well require high level support and approval.

## Navigational performance

During the life of a buoy, it is typical that its navigational performance is checked and monitored. This section captures some of the resourcing aspects associated with achieving this and will require trained staff or contractors along with proven procedures, processes and infrastructure to complete the tasks:

### Inspections

These should be completed by the owner/ provider and the results recorded for possible audit purposes this will require trained personnel and a procedure for recording the information. Competent Authorities will likely complete independent non-invasive inspections looking particularly at the position and characteristics of the buoy. The Competent Authority will record the inspections and inform the owner/ provider of any non-compliances and request notification of any corrective actions and timescales for completion, again this will require trained personnel to act as a point of contact for the Competent Authority and initiate works to rectify any outages.

### Availability

Buoy providers are required to report and publish their AtoN Availability statistics, having personnel that have the appropriate skill set to complete this task is essential. AtoN Availability statistics are a key performance indicator and can be used to demonstrate operational performance and are set by the Competent Authority as part of the initial deployment process or altered as part of an AtoN Review. For IALA Guidance refer to; R0130 (O-130) CATEGORISATION AND AVAILABILITY OBJECTIVES FOR SHORT RANGE AIDS TO NAVIGATION and Guideline 1035 AVAILABILITY AND RELIABILITY OF AIDS TO NAVIGATION ‐ THEORY AND EXAMPLES Edition 2.0

* *[poss move below ‘Availability’??]* Reporting of compliance may be required by the Competent Authority annually (on a specific date) and is based on the percentage of time the buoy is ‘available’ over a 3-year rolling period. Competent Authorities may have software to assist with this process. For details about AtoN availability see IALA Guideline ????

### Monitoring – (SEE SECTION 7.9 AS POSSIBLE DUPLICATION – This section may not be needed?????)

Monitoring of a buoy can be completed by many methods, including; user reporting, visual monitoring or remote monitoring by electronic means, each of these methods will require trained and competent staff to ensure any resultant actions are completed. Monitoring data should be recorded and is essential to be able to prove Availability, again this will require personnel, procedures and possibly hardware/software infrastructure to collate/ administer the data. For IALA Guidance refer to; GL1008 Remote control and monitoring of AtoN (GL is in the process of being updated????)

INFRASTRUCUTRE FOR MONITORING

If remote monitoring is to be adopted, then this intern will need to be financially resource for its life, but may be an enabler for other aspects. In addition, the monitoring will require some form of staffing to achieve at a suitable location, along with a suitable work structure as this can vary from 24 hour operational monitoring to exception monitoring base on changes of state.

### User reporting

This should be made easy for the mariner or member of the public, it is advisable for any deployed buoy to have some form of identification to allow users to contact the owners to report defects, this will require trained and competent staff to ensure any resultant actions are completed. Defects could include; damage to the superstructure or topmark, light outage, out of position, missing, sunk or semi sunk, vandalism, colour fade.

## Stakeholder information

### Navigational warnings

Trained staff will be required to issue navigational warnings if there are any deviations from the published position or characteristics, this includes (but not exhaustive) off position, missing, light defects, daymark missing/ broken/ discoloration, AIS/ Racon defects, fog signal defect. Depending upon the navigational significance of the buoy this may need to be published by the National Hydrographic Office, having appropriate processes in place will ensure the correct level of notification is issued. It is important to note that navigational warnings should be cancelled by the buoy owner once any defect has been rectified.

### Notice to mariners

These should be issued by trained staff to relevant stakeholders if planned maintenance or an alteration is scheduled that will affect the published characteristics of the buoy or if it is temporarily being removed or replaced by a different buoy. Any Notice to Mariners should be copied to the National Hydrographic Office who will issue updates to nautical publications and promulgated these to the Mariner. It is important to note that once a Notice to Mariners has been completed that it is cancelled or a further Notice to Mariners issued advising of the permanent characteristics of the buoy.

## Environment

With the selection and deployment of a new buoy, the environment can influence the types of resources, people, skills and equipment, which will be necessary for the buoy deployment and maintenance. This section considers some of those influences. For more guidance see IALA Guidance refer to; G1036 Environmental management in AtoN (June 2017) and G1137 AtoN management in protected areas (Dec 2017)

### Considerations for protected areas

Protected area present a challenge in how a buoy is deployed and maintained, which influences the resources need and the periodicity of maintenance visit. Below are some of the factors to consider:

* Mooring selection, for IALA Guidance refer to; R0107 Ed2.1 Moorings for floating aids to navigation and G1066 Design of Floating Aid to Navigation Moorings.
* Seabed surveys, these will need to be completed prior to deployment of new buoys to ensure there are no protected flora/ fauna within the expected scope of the mooring.
* Types of anchoring could be selected to reduce impact of the mooring material on the seabed surrounding the sinker or mooring system.
* Types of catenary, these will be selected based on the seabed environment as well as the operational and maintenance environments.

### Plastics and micro-plastics

The introduction of any form of plastic into the environment should be considered when choosing buoy construction material. For IALA Guidance refer to G1006 Plastic buoys. The selection of this material may also influence the on station life of the buoy, particularly in high UV areas.

### Marine growth

The location of a new buoy can present an opportunity for many marine species in the form of a new home. Yet it is interesting that this can be so location specific. Such marine growths will influence the type and frequency of resource need to maintain a buoy. It may also influence how such maintenance is completed and any waste is managed. I FEEL THERE IS A GUIDELINE ON THIS.

### Invasive species

Consideration should be given to prevention of introducing invasive species when deploying and maintaining buoys, local experience and information will be essential to determine any potential impacts. Buoy owners should ensure buoy tender vessels/ crew adhere to National guidance and or legislation on invasive species. Such constraints can influence the process, skills and knowledge of the crew as well as the design of the support vessel.

### Use of antifouling

This can be a positive thing from a maintenance resource prospective, reducing the servicing needs by extending the life of the buoy and periods between maintenance or scheduled buoy replacement. However, from an environmental viewpoint there are concerns associated with use of chemical bio inhibitors. See Guideline ????

### Anodes

The use of anodes will help with the reduction of corrosion in a salt water environment, but presents a maintenance demand and could influence a delicate marine environment.

### Operational area

The operational location of a buoy, such as rivers, drying tidal zones, offshore, breaking waves, ice, extreme heat and UV, to name a few, will impact on the buoy design, but may influence the resources that must be put in place for maintenance and response purposes. This could lead to a requirement for more local resource capacity.

### Aerial (Aero?) contamination

The local bird population can impact on the resources need to maintain a popular buoy such that it remains recognisable as its designed mark. The design of the buoy can influence this and for additional information see IALA guideline G1091 on Bird deterrents and bird fouling solution.

## People

People are one of the key resource requirements when considering adding a new buoy location. This may be in the form of needing new resources and skills or it could just be enhance existing resources.

### Vessel based operations

* Skills and training; National qualifications, IALA training and relevant experience of shore based and buoy tender/ vessel crew will give reassurance that the buoy construction, deployment and maintenance will be completed effectively. IALA Model Courses designed specifically for buoy works support best practice and gives reassurance to customers when purchasing buoy services or outsourcing to a third party. [IALA Model Courses : Introduction to AtoN Buoyage; Buoy Cleaning; Maintenance of Plastic Buoys; Maintenance of Steel Buoys; Power Sources on Buoys; AtoN Service Craft and Buoy Tenders; Introduction to Buoy Positions; Buoy Handling and Safe Working Practices; Buoy Moorings]
* Health & Safety: For IALA Guidance refer to; G1092 Safety Management for AtoN Activities (Dec 2017)
* Personal Protective Equipment (PPE) should be available and issued to operatives as required by National legislation and supporting risk assessments and method statements.
* Legislation on Health and Safety requirements at a National level should be adhered to.

### Shore based operations

* Back office resource: Administration of floating AtoN is essential to support the work associated with operating an AtoN, a Quality Management System may be useful to structure how records including information on installation, maintenance and outages. Details of Operation and Maintenance Manuals along with accurate records of spares held and information on suppliers will contribute to the effective management of the floating AtoN and will have an impact on the AtoN Availability throughout its lifetime For IALA Guidance refer to; Guideline Draft GL Quality Control for Third Party AtoN Service Providers, section 6.
* Quality Management Systems can be used to ensure consistent outcomes in the delivery of AtoN provision, service and compliance. For IALA Guidance refer to; O-132 Quality management of AtoN authorities and Guideline G1052 Quality Management in AtoN service delivery
* Supply chain management: timescales for the supply of services and equipment should be assessed to ensure accurate timely provision.
* Stock & procurement: appropriate stock levels of consumables items (shackles, pins, chain, rope, lanterns, batteries, solar modules, to name a few) should be assessed and procured in advance of maintenance visits or if necessary held within a stock system. If deemed appropriate, and depending upon the number of buoys deployed, lead times for procurement, reliability / availability requirements, then a complete spare buoy and mooring system may be advisable. Consideration should also be given to where stock is to be held.

## Equipment

### Shore based infrastructure

* Refurbishment facilities: consideration of the capabilities of the shore base being able to construct, service and refurbish operational buoys and recycle end of life components.
* National Standards required for operating an industrial facility and training of staff should be considered and evidenced.
* Harbour facilities: should be capable of accommodating the chosen buoy tender. The proximity of the refurbishment facility to the harbour should be considered along with where the buoy is to be deployed; other closer harbour facilities maybe considered in relation to the carbon footprint of the buoy tender, long sea voyage verses transportation by road to a closer harbour.

### Vessels

Many different types are capable of deploying buoys, consideration should be given to the individual requirements for the specific deployment, some of these are as follows:

* Capability and suitability
* Size and quantity of buoys; adequate deck space to allow all the buoys to be on the vessel at one time (potential to reduce carbon footprint)
* Crew facilities /, live aboard or local accommodation; depending upon the location of the buoy deployment if overnight passage is required the correct level of accommodation should be provided.
* Support for other 3rd parties: possible requirement to attend the buoy deployment may need the manufacturer/ supplier in attendance (example; sophisticated data gathering buoys), vessel should be capable of accommodating visitors for the duration of their stay.
* Geographical area of operation: consideration should be given to the type and number of vessels needed to cover an area to ensure adequate casualty response times as well as planned operations on the buoys within the area.
* Ice capabilities as required by the sea conditions or time of year. For IALA Guidance refer to; G1108 Dec 2013 Challenges of providing AtoN services in polar regions.
* Hot and humid climates require modified operating processes and procedures. For IALA Guidance refer to; G1136 Dec 2017 Providing AtoN services in extremely hot and humid
* Ship keeping performance suitable for the environment the vessel will be transiting and operating in.
* Quantity (also see Geographical area above)
* Response time to attend casualties is associated with the IALA Categorisation of the buoy. For IALA Guidance refer to; R0130 (O-130) CATEGORISATION AND AVAILABILITY OBJECTIVES FOR SHORT RANGE AIDS TO NAVIGATION and Guideline 1035 AVAILABILITY AND RELIABILITY OF AIDS TO NAVIGATION ‐ THEORY AND EXAMPLES Edition 2.0
* Positional accuracy
* Buoy position should be as charted, the deployment vessel should be capable of achieving the required accuracy and be able to detect when a buoy if off station (i.e. during a maintenance visit) and redeploy in the correct position.
* Hire or own the buoy tender: will depend upon the number of buoys being deployed and the maintenance service interval. Correct resourcing should be considered, if only a few buoys are deployed it is unlikely that this would justify the purchase of a vessel, however, if there are enough buoys and it makes financial sense then vessel purchase may be an option.

## Maintenance

### Failure measures

### Inspection

Periodicity; the buoy and any associated AtoN (light, Racon, AIS, fog signal) should be inspected at least annually, although in some areas this may require to be more frequent.

### Frequency of maintenance visits

Should be discussed at the development stage of the buoy construction, reviewed throughout the lifetime of the deployment in line with replacement of consumable items and will be driven by but not limited to the following:

* Colour fade of the buoy and superstructure, for IALA Guidance refer to; R108 and GL1134 Surface colours used as visual signals on AtoN and G1015 Painting AtoN buoys.
* Bird fouling can affect the daymark colour of the buoy and render solar panels ineffective. For IALA Guidance refer to; G1091 Bird deterrents and fouling solutions.
* Mooring wear – location driven – For IALA Guidance refer to; R107 Moorings for floating AtoN, G1066 Design of floating AtoN moorings
* Synthetic moorings – once sanded sinker will need to be disposed of if over stressed. Knowledge on aging is still being developed. Reduction in strength overtime due to UV. Used to avoid damage to seabed. Care under tension due to rupture.
* Operational life of equipment such as anode depletion, battery life.

### Monitoring of buoys and their associated AtoN

Is essential to ensure they are on position and operating correctly, this can be completed in many ways including scheduled regular observations by trained staff, reports from passing vessels or members of the public and remote telemetry or AIS AtoN fitted to the buoy. For IALA Guidance refer to; G1008 May 2009 Remote control and monitoring of AtoN and G1098 May 2013 On the application of AIS AtoN on buoys. ALSO SEE NAVIGATIONAL PERFORMANCE SECTION ABOVE

### Contracting out maintenance

Contracting part or all of the works associated with floating AtoN may be a consideration when a deployment is required. The owner/ provider could hire a buoy that is serviced from a third party or purchase a buoy and have a third party install and maintain it on their behalf. For IALA Guidance refer to; Guideline Draft GL Quality Control for Third Party AtoN Service Providers (see Annex 2 QUALITY CONTROL FOR THIRD PARTY BUOY SERVICES)

### Performance measures

Performance needs to be measured and monitored by the owner/ provider, most importantly to be able to prove that the AtoN is effective and achieving its purpose for the mariner. AtoN Availability Figures are a key performance indicator and can be used to demonstrate operational performance and are set by the Competent Authority as part of the initial deployment process or as part of an AtoN Review. For IALA Guidance refer to; R0130 (O-130) CATEGORISATION AND AVAILABILITY OBJECTIVES FOR SHORT RANGE AIDS TO NAVIGATION and Guideline 1035 AVAILABILITY AND RELIABILITY OF AIDS TO NAVIGATION ‐ THEORY AND EXAMPLES Edition 2.0

### Maintenance approach

This will depend upon the type, position and navigational significance of the buoy, options for maintenance processes are detailed as follows. [For IALA Guidance refer to; G1077 Dec 2009 Maintenance of AtoN.]

* Replace on failure, navigationally less significant buoys may utilise this type of maintenance approach.
* Condition based maintenance relies upon experience of wear and tear of the component parts along with expected biofouling of the buoy system and can be utilised for buoyed channels and navigationally vital or important buoys. As conditions change with climate change or other environmental factors this will develop and should be monitored and reviewed to ensure potential failures are prevented.
* Time based scheduled visits to ensure outages are kept to a minimum. This type of maintenance would be suited to buoyed channels and navigationally vital or important buoys as long as the time between visits is consistent and within the expected failure mode timescales.

### Waste disposal

Disposal of any materials as a result of the maintenance process should be completed as per National Regulations and consideration of any sensitive sea areas, this may include marine growth, depleted batteries, used chain/ ropes etc. For IALA Guidance refer to; G1036 June 2017 Environmental management in AtoN and G1137 Dec 2017 AtoN management in protected areas.

## Reliability / redundancy

### Casualty response

Casualty response times are determined by the navigational significance of the buoy therefore the defined IALA Categorisation (allocated to the buoy on initial installation or during AtoN review) give timescales to rectify faults or failures. Distance to travel and vessel availability (therefore time to respond) to rectify casualties must be factored in to the design of the buoy systems with any equipment redundancy included where appropriate.

This predominantly come in two forms, response due to a new hazard requiring buoys to mark it, or repairs to an existing buoy, up to replacement, if missing. The time frame around this will be influence but the spares and vessel arrangements, both of which are discussed in the following section.

### Spares

These will be necessary for most buoy deployments and ongoing maintenance, so consideration should be given to the following:

* Quantity held of each spare component should be determined and storage location recorded.
* Ship or shore location should be determined and implemented to ensure effective casualty response.

A key factor in providing reliable buoys. Ideally, they should be “held but never needed”, and not “needed but never held”. Yet achieving this presents a challenge. There is naturally the logistical resource to get them to the required location, even if this is transiting through the warehouse. Plus the when considering spares there are the technical challenges around right product that works first time, leading to the need for inspection or other forms of verification, along with the personnel knowledge and skills sets. Some other aspects to consider:

* Quantity held. This naturally impacts on funding tied up in spares, but is influence by failure rate, supply change management and delivery periods. This will influence the storage area needs both ashore and afloat.
* Variations in products. The few variation of buoys and designs, the fewer spares needed. It also means less likelihood of incorrect part supplied at critical times. Variations can also lead to a need for more complex parts managements.
* Ship or shore location? The location can be critical to response, but the ship can’t be a floating store. Additionally with the shore based locations, the location can be important relative to the buoys / ship operating areas. For large or developing countries, this can present a logistical challenge and cost consideration.

### Operational environment

Will impact the type of buoy that is selected for deployment, before a new buoy is chosen the following should be considered;

* Sea state at all times of the tide and year
* Drying station seabed conditions
* Rivers and debris including impacts of rain or drought on river levels
* Ice and ice flows
* High Latitudes battery requirements for lit AtoN at various times of the year
* High UV levels and impact on plastics and surface coatings

The very operational environment in which the buoy will operate in has a profound influence of the resources need to deploy, operate, and maintain it successfully. The most obvious of these the design of the support vessel, regardless of how this is obtained (owned, leased, or hired). Some examples of these influencers are:

* Sea state. – With deeper water or the need to service in more extreme conditions will result in a larger vessel, with a possible design focus on seakeeping.
* Drying station. – Generally, more inshore, hence a smaller vessel with a shallower draft and consideration around manoeuvrability and propulsion design.
* Rivers, canals, and debris. – The operational craft may need to be beam limited with a shallow draft and certainly rugged. The flow of the river will influence the performance needed.
* Ice. – This generally presents a need for a unique vessel, which may have to sacrifice some other operational properties due to this demand.
* High UV levels or extreme cold. – This will tend to lead to a support vessel providing enhanced environmental protection in the working and accommodation areas.

Besides the above, where a vessel is located, its operational area, and quantity of vessels are decision driven by the response needed, the location of spares and the operational environment.

## Third party equipment

The deployment of a buoy with third party equipment presents two competing demands. The requirement to have a reliable low maintenance buoy achieving its statutory requirements, verses. A buoy, potentially delivering a supplementary income, with the added socio-environmental benefits, but may require additional maintenance, visits and have other operational challenges. Some examples of third party equipment are:

* Meteorological Hydrological measurements and transmission (possibly on AIS AtoN systems)
* Fish sensors monitoring migratory volumes, routes and species.
* Water quality
* Bird and bat (through sound) counting

When considering the fitting of third-party equipment there are a number of technical and operational aspects to resolve. Some of these are:

* Power arrangement for the equipment – is there enough generated and stored to operate the equipment. Is this power system part of the AtoN power, or is it independent?
* Data retrieval – Is the automatic over a communication medium and is there coverage? Does it require a visit to the buoy to locally collect the data. How is either approach funded?
* Spare and failure response – Will spares need to be held on the support vessel or will the customer independently visit. How quickly does the equipment need to be repaired?
* Training – will training on supporting this equipment need to be provided to the ship’s crew or maintenance teams?
* Will the fitting of the equipment lead to additional maintenance e.g. cleaning due to bird lime.
* Can the existing structure accommodate the supplementary physical loads?

A picture containing snow, skiing, outdoor, slope

Description automatically generated **** **** ****

****

# Additional Considerations

* Monitoring (see 8.1 below)
* Position accuracy
* IALA Availability
* Scientific equipment (secondary use of buoy)

## monitoring – [Input Paper from China MSA ENG16]

### Objective of monitoring

The main purpose of buoy monitoring is to keep constant surveillance on the working status of buoy, detect existing or potential failure and intervene in time to ensure that the buoy maintains good performance. Buoy monitoring is an important supplementary means to assess performance of the buoys. As a method to match IALA availability requirement, monitoring result can be used as data to calculate the availability of the buoy. Therefore, its accuracy and comprehensiveness may affect the level of service, which the navigators are expecting from the buoy. Buoy monitoring is a complex task. There are various methods that have different effects.Competent authority should fully consider the realistic factors and the expected results, and finally make the choice that meets the requirements when deciding the monitoring methods.

### Content of monitoring

The main elements in buoy monitoring include:

1. Position.
2. Appearance and structure.
3. Working status of the lantern.
4. Working status of energy system (charging and discharging voltage, current, battery capacity,etc.)
5. Status of auxiliary equipment (such as battery, RACON, solar panel, Physical AIS device, etc.)

Generally, competent authority can select some of the elements to monitor according to priority, and the elements that may effect the performance of the buoy should be considered with higher priority, such as buoy position, lantern performance and overall structure and so on. Meanwhile, as a drifting buoy may cause obstruction to navigator instead of assistance, the position accuracy of buoy should be one of most important part to monitor, and the datum point to measure position accuracy should base on the point of sinker or anchor.

### Methods of monitoring

#### Remote monitoring

Remote monitoring system can be used to monitor buoys at different locations, and collect information of buoy status which can be accessed and shared through proper platform. A typical remote monitoring system consist of remote terminal units, communication network, data processing center and user platform. By setting up corresponding threshold to receiving parameters, authorized user can justices the performance of buoy and detects failure in time. Multiple communication networks can be used on remote monitoring system, such as cellular, terrestrial and satellite radios, microwave links, landlines, and internet. Normally, remote monitoring can only read the status data of the buoy. Some remote monitoring systems can also send instruction to set up specific parameters to realize integration of remote monitoring and remote controlling.

#### Visual check

Visual check is to maintain a regular or continuous observation to the buoy. For example,a buoy keeper /attendant continuously observes the buoy. The reliability and integrity of the buoys depend on the competence of the keeper/attendant. The advantage is that, in some cases, the keeper/attendant can intervene in failure based on his/her technical capabilities without waiting for maintenance personnel, and the keeper/attendant can completely control the buoy equipment or structure on site. The disadvantage is that, living facility for the keeper is required on site, which is difficult to meet for most buoys. In addition, the labor cost is high and the work is boring.

#### Reports from vessel

This requires AtoN administration to set up regulations for vessels to report buoy abnormality when passing by. In fact, whether the report can be made in time or not mostly depends on vessel’s navigator, the navigator may delay or fail to report. And, it means the buoy fail to play its role in aid of navigation, even can cause obstruction to navigation in some case, when reports from vessel occurs. Therefore the disadvantage of this method is that it can not detect and repair the failure in time, neither to achieve certain prediction nor prevention. Taking consideration of the uncertainty of reports from vessel, it is recommended that competent authority should set up buoy monitoring system combines with other methods.

#### Competent authority inspection

After launch of a buoy, competent authority shall organize inspection of buoy as soon as possible to ensure that the buoy can meet declared characters. In addition, the competent authority should conduct regular inspection during life cycle of the buoy, including comprehensive inspection and spot check. Generally, inspection or check hold by the competent authorities is professional and authoritative, which is significant important for solving problem or conducting subsequent maintenance of the buoy. The disadvantage is that it can not keep constant monitor of the buoy.

# Lettering [email from Partel 18/10/2022]

Where is this specified???

See guideline G1094?

*IALA G1001 - "2.1.1.2. Numbering or lettering. If marks at the sides of a channel are numbered or lettered, the numbering or lettering shall follow the “conventional direction of buoyage”. The protocol for numbering lateral marks, especially in confined waterways, should be “even numbers on red, odd numbers on green”".*

*BOWDITCH – "All solid colored buoys are numbered, red buoys bearing even numbers and green buoys bearing odd numbers. (Note that this same rule applies in IALA System A also.) The numbers increase from seaward upstream or toward land. No other colored buoys are numbered; however, any buoy may have a letter for identification."  [https://www.cal-sailing.org/images/Cruising%20Skipper%20Resources/american\_practical\_navigator.pdf](https://gbr01.safelinks.protection.outlook.com/?url=https%3A%2F%2Furldefense.com%2Fv3%2F__https%3A%2Fwww.cal-sailing.org%2Fimages%2FCruising*20Skipper*20Resources%2Famerican_practical_navigator.pdf__%3BJSU!!Of_nGou4myw!sFx4ZiiXOpUzXuftcigZJatcVY8L95Ygrp0uTykzPwWGE7l0KOwHsMkhuwMGizxjF9BEeQFrKC2ry4Abu7imVDC7TT4IO3YedOVZf9K_L_Io7g%24&data=05%7C01%7CGillian.Burns%40nlb.org.uk%7C0e14c47944be477e093c08dab1142e6d%7C29a30d8e6e9c4ea18af9a70ac84dee5a%7C0%7C0%7C638016997621975553%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=4MQwqN7nE0e%2BCGip%2BpzaSwnUaVPuxIu9ZvdTbKDIyxU%3D&reserved=0), p 77.*

# Text below this point is for information and reference only!

Initial for a AtoN is the navigational requirement, given by the nautical responsible person of an administration or third party. The following chapters give an overview about nautical requirements.

## Purpose for the buoy

At first the type of a buoy to be used is defined according to the MBS (Lateral, Cardinal etc).

In general buoys are for navigational purposes, lit or unlit. They can additionally be used for measurement tasks.

## Day ~~visibility~~ - Conspicuity

The day visibility is a mix of the following parameters:

### Range

Minimal visual distance that a buoy can be detected and the number of buoys that must be seen.

See IALA guideline 1094

(identification of shape (and colour

### Colour

The colour saccording to the MBS and IALA R0108

### Shape/daymark/Topmark

including top mark according to the MBS and IALA Guideline 1094

Visible distance

### L~~ettering~~ – Buoy Identification

according to the MBS

### Position accuracy

/availability

monitoring

## Night visibility

### Retroreflective night marking

### light

Colour

Range

Flash character (E-110 RHYTHMIC CHARACTERS OF LIGHTS ON AIDS TO NAVIGATION, table 3)

Availability (R0130) /

## radio recognition

### AIS

### RACON

### Radar reflector/Radar reflection characteristics

## audible

### Fog signal

### bell

## Availability

### position accuracy

* : daymark, light, radar reflector, AIS,
* Monitoring of position

### technical availability

* of the electronic components
* AtoN availability Cat 1, 2, or 3

## Complementary Use

* Measurement equipment
* Met /Hydro equipment
* Wave height/ current/ wind
* Information signs
* Autonomous traffic monitoring
* MASS
* Environmental monitoring / climate change
* Underwater visibility / clarity of water / turbidity
* Salinity of water
* Aquaculture monitoring

# How is the Navigational requirement achieved

## Shape

See IALA R1001 The IALA Maritime Buoyage System Ed.1 (Jun 2017)

## Day visibility

See IALA guideline 1094 provides the calculation for:

Size of the buoy’s daymark to achieve daytime visibility

Colour arrangements and dimensions

## Colours

See IALA R0108 (E-108) Surface Colours Used as Visual Signals on Marine Aids to Navigation Ed.4 (Dec 2017)

and G1134 Ed. 1 Surface Colours Used as Visual Signals on AtoN (Dec 2017)

## Lettering

Where is this specified???

See guideline G1094?

## Topmark (Daymark)

See IALA guideline 1094

Day visibility

Colour of the buoy body and superstructure.

## Retroreflective Material

See IALA R0106 (E-106) Retroreflecting Materials on Aids to Navigation Marks within the IALA MBS (Jun 2017)

and guideline 1145

## Night visibility

???

## Range of light

R0204 E200-4 Marine Signal Lights – Determination and Calculation of Effective Intensity Ed.2 (Dec 2017)

E-200-5 Marine Signal Lights Part 5 – Estimation of the Performance of Optical Apparatus 200

G1065 Ed. 3 AtoN Signal Light Beam Vertical Divergence (Dec 2017)

## Light Characteristic

E-110 Rhythmic Characters of Lights on Aids to Navigation

R0201 E200-1 Marine Signal Lights - Colours Ed.2 (Dec 2017)

G1073 Ed. 2 Conspicuity of AtoN Lights at Night (Dec 2017)

## Sound Signals

1090 The use of audible signals

## Radar Reflectors

See GGuideline under development. WG2 TG2.5.2

## Racons

IALA GUIDELINE 1010 RACON RANGE PERFORMANCE

## Automatic Identification System (AIS)

R0126 use of AIS and marine marks

1098 Application of AIS on buoys

O-143 Position of virtual AtoN

## Position

IALA Recommendation O-118 For The Recording Of Aids To Navigation Positions

# Supporting Equipment

## Availability

R1030 Categorisation and availability objectives for short range AtoN

G1035 availability and reliability of AtoN

## monitoring

IALA GUIDELINE 1008 REMOTE CONTROL AND MONITORING OF AIDS TO NAVIGATION

## Moorings

1066 Ed 1.1 The Design of Floating Aids to Navigation Moorings (Jun 2010)

E107 Moorings for floating AtoN (May 2009)

## Power systems

G1064 Integrated power systems lantern (Solar LED lanterns)

G1039 DESIGNING SOLAR POWER SYSTEMS FOR MARINE AIDS TO NAVIGATION (SOLAR SIZING TOOL)

1067-0 Selection of Power Systems for Aids to Navigation and Associated Equipment

1067-1 Total Electrical Loads of Aids to Navigation

1067-2 Power Sources

1067-3 Electrical Energy Storage for Aids to Navigation

## Buoy body performance

IALA Guideline No. 1099 on the Hydrostatic design of buoys

1006 On Plastic Buoys

## Complimentary Fit

# Monitoring

* Electronic
* Visible check (lighthouse keeper)
* ship traffic

# site conditions based on the geographical position

## The geographical position of the buoy gives the site conditions, who are:

Environmental conditions:

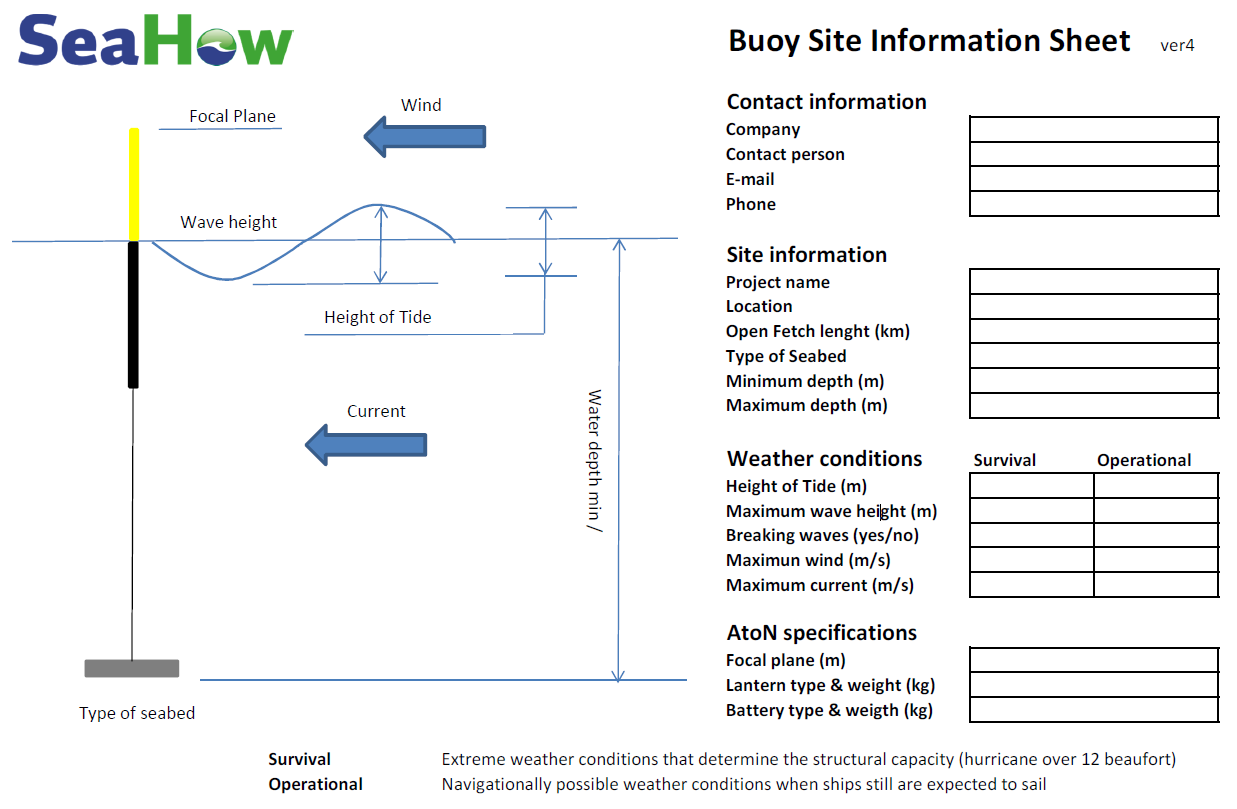
* Water depth
* Wave height
* Wave frequency / length
* Wave profile
* Current
* Wind
* Tide
* Type of Seabed – anchoring stability (stone, mud, coral)
* Mooring type required -sinker and chain/ synthetic/ hybrid types
* Marine protected area or sensitive environment
* Ice

Defining the site conditions of the location of the buoys and evaluate in the design the specifics site conditions depending on: typical, medium, maximum/operational or severe/survival conditions

# Additional technical information/specification

Additional to the nautical requirements technical information/specification is needed:

* Authority is able to specify by herself and give detailed buoy specification
* Buoy manufacturer can define, based on a questionnaire.
* Buoy manufacturers should collect the main site conditions and define the appropriate buoy characteristics. Helpful for this is a questionnaire with the following content:



* *Additional assistance from manufacturer representative would be helpful???*
* Any design demands from the customer (material of float and superstructure)
* Wave period
* Mooring system: will it be supplied by the customer or by the buoy manufacturer?
* Customer: type, size and length (weight) of the chain, diameter shackle, sinker (weight), total weight of the mooring line set
* Buoy manufacturer
* Size and capability of the support vessel
* Maintenance frequency
* Safe working and breaking load of the lifting eye
* mooring eye at the end of the wear
* Buoy equipment, supplied by the customer: position and weight, interface, antennas, etc ….
* , and the buoy itself

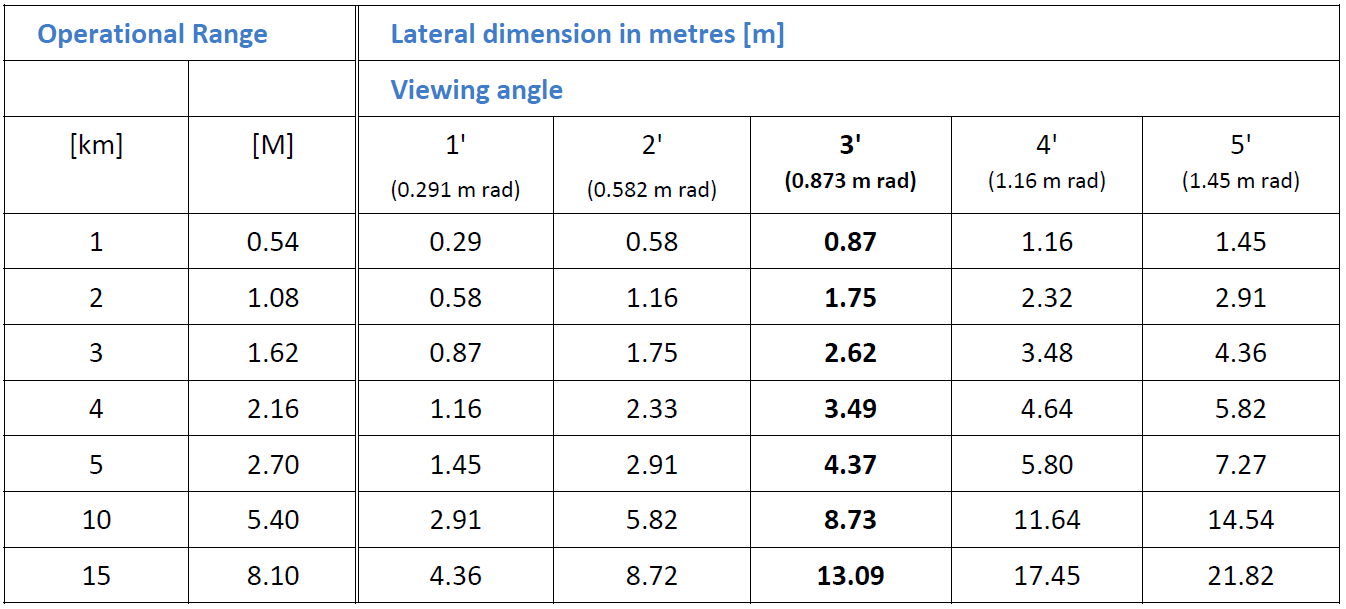
# Buoy behavior

* Stable buoy as a platform for light and other components
* hydrostatic stability
* hydrodynamic stability
* swimming behaviour in swell
* swimming behaviour in wind and current
* speed of the vessel traffic (problem to identify the character)
* behaviour in case of maintenance (handling, picking up, …)
* Ice tolerance
* impact on the performance of the radar reflector
* observer height
* ice / snow (ice loading, shadowing of the light)
* design of the mooring; mass of the mooring
* accuracy on station
* operational and survival conditions (boundary: beaufort ???)
* debris

# evaluation of the buoy CHARACTERISTICS

## Daymark

* Shape and height: calculation according to IALA 1094
* Colour: MBS (type) and R108 (specification) and G1134 Surface Colours …
* Colour fading
* Retroreflective Materials R106



## Night Visibility

Range calculations??

How do you select the appropriate lights

Vertical divergence of lantern - Trinity House Paper?

## Additional factors

Radar reflector

Complementary use

Radio AtoN

Audible

## buoy body

* The height of the daymark leads to the minimum focal plane of the buoy.
* The buoy body (diameter) must be big and stable enough to carry the daymark (superstructure).
* The total weight, the height and the weight distribution lead to the
  + Buoyancy
* Diameter and Decision about steel float or plastic float lead to the main construction details :
* -> hydrostatic calculation according to IALA G1099

Calmar-Software

# Operational behaviour

* mass of the buoy
* design of the buoy (different materials, ballast, shapes, …)
* mass and design of the mooring system
* demands on the lifting eye (amount, size, location, …)
* demands on the mooring eye (amount, size, location, wear…)
* maintenance on site according to IALA GUIDELINE 1077 MAINTENANCE OF AIDS TO NAVIGATION, Annex A and B
* maximum acceleration and forces (destroying of parts of the buoy)
* ground path (especially plastic buoys)
* Collision behaviour
* two or more compartments
* float-filling material
* impact resistance or tolerance
* special conditions behaviour (big waves, etc.)
* Environmental behaviour (especially plastic buoys)
* technological use of plastic
* disposal / recycling

# Buoy Selection

-

Type of buoy

• Defining the local service capabilities

• Defining the equipment, power requirements and power source(s)

• Selecting the initial type proportions (buoy type)

• Selecting the mooring for the buoy

• integrating of equipment and power supply (same as line 4)

• considering of the maintenance requirements

• identifying deployment and recovery techniques (same as line 3)

• protecting equipment from damage, vandalism and guano

• providing the ability to rectify faults without having to lift the buoy (depending on the country regulations)

• determining the buoy response to the wave, wind and current conditions at the site(s)

• optimising the design, bouyancy and the material

# Verification of buoy choice:

relationship between nautical requirements and buoy characteristics

• Discuss the relationship between nautical requirements and buoy characteristics

• Identify measurement methods for the dynamic pe

# Content from Paper – 2.5.3

Creating an overview guideline or recommandation on floating AtoN

Buoy related information is available in many IALA guidelines and other IALA documents.

Create a guideline or recommandation “floating marine aids to navigation” with an overview of related guidelines and further documents relating to floating AtoN and evaluate if they are adaptable to buoys.

Definition of floating marine aids to navigation (Light vessels, Light floats, Buoys)

• Light vessels: A vessel anchored at a designated geographical location as an aid to navigation, to mark a hazard or to serve as a landfall mark. It is equipped with a light of high luminous intensity and may carry a fog signal emitter, a racon, a radiobeacon or other aids to navigation as required by the particular station. It may or may not be self-propelled.

A light vessel serves also as a conspicuous navigation mark by day. For this reason the hull and the lantern support tower are usually coloured red. The name of the station is exhibited on either side of the vessel.

Please note that this is the term as it stands in the original IALA Dictionary edition (1970-1989)

• Light floats: A boat-like structure used instead of a light buoy in waters where strong streams or currents are experienced, or when a greater elevation than that of a light buoy is necessary.

Source: IHO Dictionary – S-32, provided by the IALA ARM Committee in paper ARM7-12.1.7 in 2017.

This supercedes definition number 8-2-020 in the original IALA Dictionary edition (1970-1989).

• Buoys: A floating, and moored, artificial navigation mark. It can be recognized by means of its shape, colour, pattern, topmark or light character, or a combination of these. It may carry various additional aids to navigation.

Note 1 :

The terms light buoy and lighted buoy refer to a buoy that is fitted with a signal light.

Note 2 :

The term high focal plane (HFP) buoy may be used for a light buoy on which the signal light is fitted particularly high above the waterline.

Note 3 :

The terms unlighted buoy and blind buoy refer to a buoy that is not fitted with a signal light.

Please note that this is the term as it stands in the original IALA Dictionary edition (1970-1989)

Look for the existing IALA Guidelines and further documents

Buoy body

• IALA NavGuide 2018

• E-107 Moorings for Floating Aids to Navigation

• R0106 (E-106) Retroreflecting Materials on Aids to Navigation Marks within the IALA MBS (Jun 2017)

• R0108 (E-108) Surface Colours Used as Visual Signals on Marine Aids to Navigation Ed.4 (Dec 2017)

• R1001 The IALA Maritime Buoyage System Ed.1 (Jun 2017)

• IALA Recommendation O-118 For The Recording Of Aids To Navigation Positions

• 1006 On Plastic Buoys

• 1066 Ed 1.1 The Design of Floating Aids to Navigation Moorings (Jun 2010)

• 1077 Ed. 1 Maintenance of Aids to Navigation (Dec 2009)

• 1091 Ed. 1 Bird Deterrents (Dec 2016)

• 1109 Ed. 1 Theft and Vandalism Deterrents (Dec 2013)

• G1140 Ed. 1 Commissioning of AtoN Equipment and Systems (Dec 2017)

• IALA Guideline No. 1099 on the Hydrostatic design of buoys

• 1015 Painting aids to navigation buoys 1015

• IALA GUIDELINE 1108 THE CHALLENGES OF PROVIDING AtoN SERVICES IN POLAR REGIONS

• GUIDELINE G1136 PROVIDING AtoN SERVICES IN EXTREMELY HOT AND HUMID CLIMATES

• GUIDELINE G1127 SYSTEMS AND SERVICES FOR HIGH ACCURACY POSITIONING AND RANGING

• WWA L2.6.1-2 AtoN Service Craft and Buoy Tenders

• WWA L2.1.8 Buoy Cleaning

• WWA L2.1.5-6 Buoy Handling and Safe Working Practices

• WWA L2.1.7 Buoy Moorings

• WWA L2.1.3-1.4 Introduction to AtoN Buoyage

• WWA L2.1.9 Introduction to Buoy Positions

• WWA L2.1.10 Maintenance of Plastic Buoys

• WWA L2.1.11 Maintenance of Steel Buoys

• WWA L2.1.12 Power Sources on Buoys 01 June 2016

Buoy equipment

• 1098 Application of AIS AtoN on Buoys

• IALA GUIDELINE 1010 RACON RANGE PERFORMANCE

• IALA GUIDELINE 1090 THE USE OF AUDIBLE SIGNALS GUIDELINE

• G1039 DESIGNING SOLAR POWER SYSTEMS FOR MARINE AIDS TO NAVIGATION (SOLAR SIZING TOOL)

• 1067-0 Selection of Power Systems for Aids to Navigation and Associated Equipment

• 1067-1 Total Electrical Loads of Aids to Navigation

• 1067-2 Power Sources

• 1067-3 Electrical Energy Storage for Aids to Navigation

• IALA GUIDELINE 1008 REMOTE CONTROL AND MONITORING OF AIDS TO NAVIGATION

Light

• E-110 Rhythmic Characters of Lights on Aids to Navigation

• E-200-0 Marine Signal Lights Part 0 – Overview 200

• E-200-3 Marine Signal Lights Part 3 – Measurement 200

• E-200-5 Marine Signal Lights Part 5 – Estimation of the Performance of Optical Apparatus 200

• R0201 E200-1 Marine Signal Lights - Colours Ed.2 (Dec 2017)

• R0202 E200-2 Marine Signal Lights – Calculation Definition and Notation of Luminous Range Ed.2 (Dec 2017)

• R0204 E200-4 Marine Signal Lights – Determination and Calculation of Effective Intensity Ed.2 (Dec 2017)

• 1048 Ed. 1 LED Technologies and their use in Signal Lights (Dec 2005)

• G1065 Ed. 3 AtoN Signal Light Beam Vertical Divergence (Dec 2017)

• G1073 Ed. 2 Conspicuity of AtoN Lights at Night (Dec 2017)

• G1134 Ed. 1 Surface Colours Used as Visual Signals on AtoN (Dec 2017)

• G1135 Ed. 1 Determination and Calculation of Effective Intensity (Dec 2017)

• IALA GUIDELINE 1064 INTEGRATED POWER SYSTEM LANTERNS (SOLAR LED LANTERNS)

Availability

• R0130 (O-130) Categorization and Availability Objectives for Short Range Aids to Navigation Ed.2 (Jun 2017)

• Availability and Reliability of Aids to Navigation 1035

Software

• IALA CALMAR Mooring Line Calculation Software

• AtoN light flash simulator

Other

• R1002 The Management for Marine Aids to Navigation Ed.1 (Jun 2017)

Add 1094

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

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

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

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

*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
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)