



IALA GUIDELINE

GNNNN MAINTENANCE OF FLOATING ATON

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1. INTRODUCTION

Maintenance is required to ensure that Marine Aids to Navigation (AtoN) equipment and systems continue to perform at the levels required by mariners to safely navigate the world's waterways. Floating AtoNs have specific requirements and challenges in relation to maintenance.

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2. PURPOSE

The purpose of this guideline is to provide an overview on the approach to be taken in relation to the maintenance of floating AtoNs by a Competent Authority (CA). It should be noted that to floating AtoNs refers to all component of all types of floating AtoNs including mooring, sinker, buoy body, superstructure, topmark and all other components. The guideline should assist CA in the development of maintenance plans for floating AtoNs but CA must also consider the local factors appropriate to them and the nature, type and quantity of floating AtoNs being maintained. This guideline should be read together with Guideline 1186 which provides an overview on floating AtoN.

This guideline is primarily written to inform about the inspection and maintenance of floating AtoN, and the parts are constructed with different materials such as Glass Reinforced Plastic (GRP), plastic, steel, aluminium, or cast iron. The assumption of the locations of work varies from being on the site, onboard the buoy tender or on land in a buoy depot – each site having its own inherent risks and hazards during operation. The reader should make their own assessment if some of the information within the guideline is relevant for their own operations.

2.1. MAINTENANCE OF FLOATING AIDS TO NAVIGATION

Guideline 1077 sets out the approach to be taken in relation to the development of an overall strategy for the maintenance of AtoN. Competent Authorities (CA) should prepare an overall maintenance strategy for all AtoN under their control. This strategy should take account of the resources available to the CA and the maintenance philosophy to be adopted when undertaking maintenance.

Additionally, Guidelines 1006, 1066, 1175 and 1099 provide information on the design of buoys and components and other matters. CA should take cognisance of these guidelines and the specific design parameters of each floating AtoN when developing the maintenance plans. In addition, historical information related to the performance of the AtoN from previous maintenance inspections or in the maintenance strategy as set out in Guideline 1077 when determining the required intervals for any maintenance activities.

Commented [102]: Do we mention G1175 too?(Philippe)

2.2. MAINTENANCE PLANNING AND PREPARATION

In developing a maintenance plan for floating AtoN, the following non-exhaustive considerations are for reference:

- Prepare the list of all floating AtoN to be maintained including category and location to support prioritisation of maintenance.
- Floating AtoN technical data (design, drawings, specifications and manufacturers information).
- Floating AtoN specific mooring data (design, drawings and specification).
- Ensuring that sufficient spare parts are available for all elements of the floating AtoN and moorings in accordance with the maintenance plan.
- Previous maintenance records and reports to confirm what work is required or identifying patterns of failure.
- A safe system of work should be in place for all maintenance activities.
- Proper Personal Protective Equipment (PPE) should be checked and provided for all personnel involved.
- Proper training certification and qualification of the personnel involved for each type of work should be checked and adhered to.

In addition, environmental factors will impact the ability of competent authorities to undertake maintenance so this must be considered when developing maintenance plans.



The maintenance of floating AtoNs may include works to be undertaken to ensure the reliable and effective operation. The level of maintenance undertaken will be in accordance with the AtoN Maintenance Strategy developed in accordance with G1077 by the Competent Authority. The maintenance works undertaken to floating AtoNs should consider if or when periodic replacement or renewal is required.

Commented [113]: I need informations to understand the purpose of these following paragraphs (Philippe)

2.3. REGULATORY CONSIDERATIONS

In accordance with the Maintenance Strategy Developed under Guideline 1077, the maintenance plan should identify the maintenance activities required to ensure compliance with the relevant local, national and international regulations. In addition to this all maintenance should also be undertaken in accordance with relevant local, national and international regulations.

Commented [114]: I agree. Could we write or summarise the main items: hyperbar works, lift works, winch work, sea work, heigh works (Philippe)

2.4. SAFETY CONSIDERATIONS

The maintenance of floating AtoN can be a hazardous activity that requires careful planning, assessment and execution. Environmental conditions and the condition of a AtoN, which is due for maintenance, can aggravate hazards and increase the level of risk.

Wherever possible, the maintenance of floating AtoNs should be undertaken by first recovering the floating AtoN onto a suitable working platform or onboard the buoy tender vessel. However, it is recognised that the nature and type of floating AtoN as well as the resources available to the Competent Authority (CA) may limit the use of a vessel working platform or buoy tender vessel.

The CA should ensure that personnel are trained and have attained the relevant certifications, and lifting equipment such as cranes, winches, lifting belts, shackles are maintained correctly in accordance with local/national requirements for such lifting equipment.

The CA should ensure the hazards associated the presence of marine growth which can cause irritation to the skin from any cuts suffered from sharp edges. This hazard will be particularly relevant in relation to components of the floating AtoNs beneath the surface of the water.

In all cases, the CA must ensure that a safe system of work is developed in accordance with the legislation relevant to their jurisdiction as part of the floating AtoN maintenance plan to ensure that all the hazards and the risks arising from undertaking maintenance are suitably assessed and control measures implemented.

Attention is drawn to the hazards associated with the maintenance for floating AtoNs:

- All diving works should be properly planned and delivered in accordance with local regulations. All divers must be competent and suitably trained to undertake the required works.
- Lifting/winch hazards:
 - Prior to any maintenance it is essential to locate and inspect all lifting eyes prior to all lifting operations and when connecting the mooring system to the buoy. Refer to designers/manufacturers recommendations.
 - Items entangled with the AtoN or failure of parts of the mooring assembly during lifting operations
 - Crush hazards during lifting
 - Weight of heavy components at top of superstructure creates a hazard when maintaining floating AtoN
- Working at Height
- Electrical hazards working on electrical components
 - Hydrogen built up within the battery compartment



- Radiation hazards associated with transmitting equipment on floating AtoN
- Hazards from the different battery types - chemical exposure or fire
- Slips, trips and falls noting that floating AtoN surfaces may be slippery if wet or fouled with seaweed or bird guano.
- Health hazards such as bird guano and certain dangerous marine organisms.
- Poor sea state that increases difficulty in accessing AtoN at sea and affects lifting operations.
- Working over or adjacent to water, falls overboard or off floating AtoN– causing drowning, secondary drowning or cold-water immersion
- Extreme temperatures (hot or cold)-Reference Guideline 1175
- If possible, work should take place during daylight hours.

2.5. ENVIRONMENTAL CONSIDERATIONS

Environmental factors have a significant impact on the degradation of floating AtoN components. In addition, environmental factors will impact the ability of competent authorities to undertake maintenance so this must be considered when developing maintenance plans. The maintenance plan should consider the following environmental constraints:-

- Distance of floating AtoN from shore
- Oceano meteorological conditions (sea state, current, salinity, tide wind, visibility)
- Extreme Temperature(hot or cold)-Reference Guideline 1175

The maintenance of floating AtoN should consider the impact to the environment, noting that maintenance of the AtoNs may create environmental waste or other by products. This should be considered strategically in accordance with the Aton Maintenance Strategy Developed in accordance with G1077. The maintenance plan should consider the following elements:-

- Minimising and proper disposal of waste created
 - Impact on the seabed of recovering and replacing the sinkers or anchors
 - Maximising maintenance intervals to reduce emissions
 - The design life of components should be maximised so that the maintenance frequency can be prolonged
 - Environmental restrictions impacting the timing of maintenance
 - Promoting the use of environmentally friendly products for cleaning
 - Prevention of pollution of the waterway

2.6. MAINTENANCE INSPECTION

The inspection of assets and components should be undertaken as part of the maintenance of floating AtoN. Inspections can be undertaken during maintenance works or may take place separately depending on the maintenance strategy that has been adopted by the Competent Authority (CA). A regular visual inspection of floating AtoN is recommended as a minimum to ensure reliable operation. The CA defines the periodicity of the visual inspection. The CA should also be aware that the harsh marine environment in which the floating AtoNs are deployed will wear down each component of the floating AtoN. The CA should have a maintenance schedule for the replacement of these components in good time before they fail, an example of which is the measuring of the mooring chains and determining how much wear is permissible before they are replaced. |

Commented [115]: Shouldn't we give any examples Salinity, UV beams, heat, frozen, debris, ice, fauna and flora, external action strengths (waves, wind, etc.), (Philippe)

Commented [116]: Could we add that it is useful to record all the actions and measures done in a "AtoN copybook" for traceability? (Philippe)



2.7. MAINTENANCE WORKS

The maintenance of floating AtoNs may include works to be undertaken to ensure that the reliable and effective operation of them. The level of maintenance undertaken will be in accordance with the Competent Authority's AtoN Maintenance Strategy developed in accordance with G1077. The maintenance works undertaken to floating AtoN should consider if or when periodic replacement or renewal of the floating AtoN is required. This may also be part of the maintenance plan.

It is also important to consider Manufacturers specifications, requirements and recommendations, especially on end-of-life of components, when planning the maintenance. In accordance with the maintenance strategy as set out in G1077, all maintenance work should be recorded to support the planning of all future maintenance and provide a historical record for future reference.

Commented [CS7]: Insert comment in relation to undertaking maintenance in accordance with manufacturers guidelines etc.

3. FLOATING ATON COMPONENTS MAINTENANCE

The requirements for each component of the floating AtoN differs and the section below considers these differences for each component in relation to the risks and issues that are likely to occur. These requirements are considered to be best practice and Competent Authorities should ensure that they take account of local factors relevant to their area in developing maintenance plans for each component. Guideline 1186 should be used for reference in relation to floating AtoN components.

3.1. MOORING SYSTEM

3.1.1. RISKS AND ISSUES

Visual inspections and maintenance works are usually carried out on a buoy tender. Breakage within the mooring system, such as shackles, swivels and links, while lifting under tension, could occur. Different parts of the mooring arrangement may also have different rate of corrosion and pitting may occur within the mooring system.

Crew should be aware that submerged chain might be subjected to corrosion from the sea water resulting in decreased safe working loads. The safe working load of synthetic mooring line decreases with time deployed and caution should be taken to prevent injuries from snapping.

Attention should be given to potential entanglement of the mooring system such as entanglement of the ground chain with seabed or the sinker or the chain/synthetic mooring with its subsurface or surface float. Depending on the seabed material, the sinker/anchor may be embedded resulting in difficulties when recovering.

In some specific mooring operations, diving operations may be required for certain works, for example, taut mooring, underwater inspection of the floating AtoN's components, or inspection of the anchoring eye on the sinker. This should also adhere to local regulations and safety standards. Divers deployed should have suitable certifications and training.

Competent Authorities should plan for the proper disposal of old components to adhere to local environmental requirements.

The crew shall also be aware of the marine growth on the mooring components, which may result in cuts and irritation, due to the sharpness or difficulties to visually inspect the components.



3.1.2. INSPECTION REGIME

How

The mooring system can be inspected visually and measurements taken by either choosing to lift the entire mooring system onto the deck of the buoy tender or by conducting a diving inspection.

What

The following inspection is recommended:

Component	Inspect for	Action to be done
Mooring assembly (swivels, shackles, chain links)	Damage, corrosion, wear and tear	Replace or repair
	Correct Operation (swivels)	Replace or repair
	Integrity(shackle pins), tightness	Replace or tightened to correct torque values
Synthetic ropes	Integrity of mooring eye, integrity of the rope, splice,	Replace

3.1.3. MAINTENANCE

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Mooring assembly	Cleaning and removal of marine growth, fishing nets and debris	High pressure water jet Brush Scraper Hammer
	Replace of worn chain, shackles, swivels	New chains, shackles, swivels Cutting equipment
	Thickness	Measuring gauge Vernier calliper
Sinker	Reweld or repair of worn-down anchoring eye	Welding equipment
Synthetic rope	Replace any damaged/torn/cut synthetic mooring rope, eyes	New synthetic rope



Figure 1 Chain Wear



Figure 2 Chain Measurement



Figure 3 Example of excessive wear around shackle pin



Figure 4 Abrasion/damage to rope

3.2. TOPMARK

3.2.1. RISKS AND ISSUES

Due to constant exposure to the harsh marine environment, the topmark may be subjected to corrosion, UV damage and vibration damage. As it is located at the top of the floating AtoN, considerations should be given to suitable climbing access from the float on the superstructure and safety due to unfavourable environment affecting the stability of the floating AtoN.

3.2.2. INSPECTION REGIME

How

The topmark can be inspected visually on the deck of the buoy tender or on station.

What

The following inspection is recommended:

Component	Inspect for	Action to be done
Topmark	Cleanliness	Clean



	Damage, corrosion, wear and tear	Replace or repair
	Correct colour	Repaint or replace
	Integrity, tightness	Replace or tightened to correct torque value

3.2.3. MAINTENANCE

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Topmark	Cleaning	Cleaning equipment Painting system
	Repainting	Tools for preparation Painting system
	Repair	Welding equipment
	Replace	New topmark



Figure 5 Topmark bolted and welded connections to be inspected



Figure 6 Deformed/Bent topmark

3.3. SUPERSTRUCTURE

3.3.1. RISKS AND ISSUES

Consideration should be given to safety due to unfavourable environment affecting the stability of the floating AtoN. Safe access should be given to personnel working on the superstructure to prevent personnel from falling into the sea. As the superstructure is exposed to the harsh marine environment, there will be corrosion of the components resulting in material damage, and colour fading due to UV damage. Personnel should take note of the type of materials chosen for replacement components to avoid dissimilar materials to be used on the superstructure as these will cause increased bi-metallic corrosion. The presence of bird guano can also result in a health hazard.

3.3.2. INSPECTION REGIME

How

The superstructure can be inspected visually on the deck of the buoy tender or on station.



What

The following inspection is recommended:

Component	Inspect for	Action to be done
Superstructure	Cleanliness	Clean
	Damage, corrosion, wear and tear	Replace or repair
	Correct colour	Repaint or replace
	Integrity, tightness	Replace or tightened to correct torque value
Ladder/Access/Working Platform/Man guard	Damage, corrosion, wear and tear	Replace or repair
Hinges	Damage, corrosion, wear and tear	Replace or repair
Lifting eyes	Damage, corrosion, wear and tear	Replace or repair
	In accordance with local regulatory requirement	Check and repair if necessary

3.3.3. MAINTENANCE

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Superstructure	Cleaning	Cleaning equipment
	Painting	Tools for preparation Painting System
	Repair	Welding equipment
Ladder/Access/Working Platform/Man guard	Replace or repair	New ladder/man guard/working platform Welding equipment
Hinges	Replace or repair	Replacement items Welding or securing equipment
Fasteners	Integrity	To tighten to correct torque value
Lifting pad eyes	Replace or repair	Welding equipment
Lifting eyes	Damage, corrosion, wear and tear	Replace or repair
	In accordance with local regulatory requirement	Check and repair if necessary



Figure 7 Example of buoy superstructure before assembly



Figure 8 Topmark fasteners, welding and lifting eyes must be inspected



Figure 9 Ladders and Safety devices must be inspected

3.4. DAYMARK

3.4.1. RISKS AND ISSUES

Considerations should be given to safety due to unfavourable environment affecting the stability of the floating AtoN. Vibrations from the wind or wave actions may also result in fasteners becoming loose. Proper access should be given to personnel working on the floating AtoN to prevent personnel from falling into the sea. As the daymark is exposed to the harsh marine environment, there will be corrosion of the components resulting in material damage, and colour fading due to UV damage. Personnel should take note of the type of materials chosen for replacement components to avoid dissimilar materials to be used as these will cause increased galvanic corrosion. The presence of bird guano can also result in health hazard.

3.4.2. INSPECTION REGIME

How

The daymarks can be inspected visually taken on the deck of the buoy tender or on station.



What

The following inspection is recommended:

Component	Inspect for	Action to be done
Daymarks	Cleanliness	Clean
	Damage, corrosion, wear and tear	Replace or repair
	Correct colour	Repaint or replace
Fasteners	Integrity, tightness	Replace or tightened to the correct torque value

3.4.3. MAINTENANCE

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Daymarks	Cleaning	Cleaning equipment
	Painting	Tools for preparation Painting System
	Integrity	Tools/torque wrench to tighten
	Replace or repair	New daymarks Tools required to replace daymark
Fasteners	Integrity	To tighten to correct torque value



Figure 10 Bird fouling and marine growth should be cleaned



Figure 11 Colour of daymark must be checked



Figure 12 Confirmation of colour using reference card

3.5. FLOAT

3.5.1. RISKS AND ISSUES

As the float is exposed to the harsh marine environment, there will be corrosion of the components resulting in material damage, and colour fading due to UV damage. Personnel should take note of the type of materials chosen for replacement components to avoid dissimilar materials to be used on the float as these will cause increased bi-metallic corrosion. Depending on the float material, different methods of cleaning and different tools maybe required to avoid damage to the buoy flat. The presence of bird guano can also result in health hazard.

Personnel should be aware that the float may be damaged due to impact from vessel or water ingress due to holes in the float body, and it is important to visually assess that the reserve buoyancy of the float is sufficient for personnel to be standing for works.

In plastic buoys, connections between individual plastic modules should be checked to ensure the fasteners are not loose. For GRP buoys, care should be taken to prevent cuts from any damaged material.

Lifting and mooring pad eyes should be checked to ensure that the diameter of the material and their welded connections are not degraded and always undertaken prior to any lifting operation commencing.

Underwater surfaces may not be visible to personnel working on the float, these areas may require divers to check, especially on the condition of any anodes installed.

3.5.2. INSPECTION REGIME

How

The float can be inspected visually by either choosing to lift the entire floating AtoN onto the deck of the buoy tender or by conducting a diving inspection or at a buoy yard.

What

The following inspection is recommended:

Component	Inspect for	Action to be done
Float	Cleanliness	Clean
	Damage, corrosion, wear and tear	Replace or repair
	Correct colour	Repaint or replace



	Integrity, tightness of all connections	Repair of any holes found Replace or tightened to correct torque value Removal of any water ingress Pressure test to be conducted to check for airtightness
Lifting eyes	Damage, corrosion, wear and tear (consider local regulatory requirement)	Replace or repair Check and repair if necessary
Mooring eyes	Damage, corrosion, wear and tear (consider local regulatory requirement)	Replace or repair Check and repair if necessary
Plastic modules	Tightness of connecting fasteners	Replace or tightened to correct torque value

3.5.3. MAINTENANCE

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Float	Cleaning	Cleaning equipment
	Repainting	Tools for preparation Painting system
	Repair or replace	Welding equipment or New plastic modules or spare parts Manufacturers repair kit
	Pressure testing for hull integrity	Source of pressurised air Pressure gauge Soap water
Fasteners	Integrity	Tighten to correct torque value
Lifting pad eyes	Replace or repair (in accordance with local regulatory requirement)	Welding equipment Replacement lifting eyes Check and repair if necessary
Mooring pad eyes	Replace or repair (in accordance with local regulatory requirement)	Welding equipment Replacement mooring eyes Check and repair if necessary



Figure 13 Figure Stability of buoy verified



Figure 14 Water ingress in buoy floats may occur



Figure 15 High pressure water jet cleaning of buoy



Figure 16 Removal of marine growth by scraping



Figure 17 Check the sacrificial anodes



Figure 18 Check the lifting eyes



Figure 19 Tightening of loose plastic float connections

3.6. TAILTUBE/SKIRT

3.6.1. RISKS AND ISSUES

The tailtube/skirt is normally underwater. A diving inspection may be required if the inspection is conducted without removing the buoy from the water. Otherwise, the floating AtoN can also be lifted onto the deck of a buoy tender for easier inspection/repair to the tailtube/skirt.

There will be corrosion of the components resulting in material damage. Personnel should take note of the type of materials chosen for replacement components to avoid dissimilar materials to be used on the tailtube/skirt as these will cause increased bi-metallic corrosion. The overall condition of the material should be checked to ascertain if there are deformation of the tailtube/skirt or any connections around the float and tailtube/skirt interface or blockages to the vent holes.

In plastic buoys, mooring pad eyes should be checked to ensure that the diameter of the material and their welded connections are not degraded. Anodes may be installed, and the condition of the anodes should be inspected and replaced if necessary.

3.6.2. INSPECTION REGIME

How

The tailtube/skirt can be inspected visually by either choosing to lift the entire floating AtoN onto the deck of the buoy tender or by conducting a diving inspection.

What

The following inspection is recommended:

Component	Inspect for	Action to be done
Tailtube/Skirt	Cleanliness	Clean
	Damage, corrosion, wear and tear	Replace or repair
	Degradation of protective coating	Repaint or replace



	Integrity, tightness	Repair of any holes found Replace or tightened to correct torque value
Venting Holes	Obstructed with organic material	Clear material
Mooring eyes	Damage, corrosion, wear and tear(consider local regulatory requirement)	Replace or repair Check and repair if necessary
Drift plates	Damage, corrosion, wear and tear	Replace or repair

3.6.3. MAINTENANCE

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Tailtube/Skirt	Cleaning	Cleaning equipment
	Repainting	Tools for preparation Painting system
	Repair	Welding equipment or New tailtube
Drift plate	Replace or repair	Welding equipment or New drift plate
Fasteners	Integrity	To tighten to correct torque value
Mooring pad eyes	Replace or repair(in accordance with local regulatory requirement)	Welding equipment Replacement mooring eyes Check and repair if necessary



Figure 20 Check the drift plate and lifting eye



Figure 21 Check main mooring eye



3.7. BALLAST

3.7.1. RISKS AND ISSUES

The ballast is generally installed onto a floating AtoN to aid in its stability. There are different types of ballast which can be fitted, such as concrete weights, steel blocks or in some instances, concrete can be poured within the buoyancy chamber.

There will be corrosion of the ballast which results in material damage, especially if iron is used. Personnel should take note of the type of materials chosen for replacement components to avoid dissimilar materials being used as these will cause increased bi-metallic corrosion. If dissimilar materials are used, considerations to be made to isolate the materials to reduce the bi-metallic corrosion.

Any loss of ballast may result in instability of the floating AtoN. Any loss of ballast should be replaced (similar mass and material) to regain the designed stability.

3.7.2. INSPECTION REGIME

How

A visual inspection of buoy stability may indicate a problem with the ballast which should be assessed prior to any other maintenance. The ballast can be inspected visually by either choosing to lift the entire floating AtoN onto the deck of the buoy tender or by conducting a diving inspection.

What

The following inspection is recommended:

Component	Inspect for	Action to be done
Ballast	Stability	Visual inspection of buoy at sea in context of environmental conditions
	Damage, missing, corrosion, wear and tear	Replace missing or damaged ballast Clean
	Tightness of securing bolts (if any)	Replace or tightened to correct torque value

3.7.3. MAINTENANCE

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Ballast	Cleaning	Cleaning equipment
	Add/Remove ballast to adjust stability Replace missing ballast	New ballast
	Repair	Welding equipment or New welding



	Checking of tightness of securing bolts	Torque wrench
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Figure 22 Heavily corroded ballast



Figure 23 Replacement of ballast sections

4. EQUIPMENT

4.1. POWER SYSTEM

Power system, within this guideline, refers to the solar panels and power storage systems such as batteries and associated supporting systems (battery monitoring system and voltage regulator etc). In some rare cases, the power required may be generated using a wave or wind turbine.

4.1.1. SOLAR PANELS

The most common form of power generation for a floating AtoN is solar panels. The lifespan of a solar panel is determined by the manufacturer. The replacement of the solar panels should take into account the manufacturer's recommendations. For more detailed information, please refer to IALA Guideline G1186 Overview of a Floating AtoN and G1170 Solar Modules for a Marine Environment.

4.1.2.1. Risks and Issues

Damage to solar panels can occur due to physical damage from wildlife or impact damage from physical contact of the floating AtoN by vessels or damage during the lifting of the floating AtoN by the buoy tender. Bird guano can obscure solar panels reducing their effectiveness as well as other issue such as dust or ice. Temperature extremes will also impact the effectiveness of solar panels. Separately water ingress may occur in junction boxes or the fasteners/securing devices may fail. Solar panels are also prone to theft or vandalism.

4.1.2.2. Inspection Regime

How

Visual inspection and measurement of equipment using suitable measuring devices.

What

The following inspection is recommended:

Component	Inspect for	Action to be done
Solar Panels	Damage, corrosion, wear and tear	Replace or repair



	Tightness of fasteners	Replace or tightened to correct torque value
	Electrical continuity	Measure and check
	Cleanliness	Wash and clean
Cables	Damage, corrosion, oxidation	Replace or repair or clean

4.1.2.3. Maintenance

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Solar Panels	Cleaning	Cleaning equipment
	Replacement of damaged or corroded components	Replacement solar panels
	Checking of tightness of fasteners or electrical terminals	Torque wrench and other tools
	Checking of electrical continuity	Measuring equipment
Cables	Checking security of connectors and junction boxes	New connectors Tightening tools



Figure 24 Damaged solar panel



4.1.3. ENERGY STORAGE SYSTEM – BATTERIES

The most common form of energy storage for a floating AtoN is the battery. There are multiple types of batteries available such as lead acid or lithium ion. The lifespan of a battery is determined by the manufacturer. The replacement of the batteries should take into account the manufacturer's recommendations. For more detailed information, please refer to IALA Guideline G1186 Overview of a Floating AtoN and G1067-3 Electrical Energy Storage for AtoN. It is also important to check the condition of cables linking the various components to the power source.

4.1.3.1. Risks and Issues

Temperature extremes will impact the effectiveness of batteries. Separately water ingress may occur in battery compartment boxes. Batteries are also prone to theft or vandalism.

4.1.3.2. Inspection Regime

How

Visual inspection and measurement of equipment using suitable measuring devices.

What

The following inspection is recommended:

Component	Inspect for	Action to be done
Batteries	Damage, corrosion, oxidation	Replace or repair or clean
	Tightness of fasteners	Replace or tightened to correct torque value
	Electrical continuity	Measure and check
	Watertightness of battery compartment	Check for watertightness
	Secure compartment or installation	Check for any looseness and tighten if necessary
	Proper ventilation of battery compartment	Ensure proper ventilation provided Inspect and ensure breather valve is operational (if applicable)
Cables	Damage, corrosion, oxidation	Replace or repair or clean
	Checking security of connectors and junction boxes	New connectors Tightening tools

4.1.3.3. Maintenance

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Batteries	Cleaning of corrosion on terminals	Cleaning equipment



		Applicable or suitable grease to terminals
	Replacement of damaged or corroded components	Replacement
	Checking of tightness of fasteners or electrical terminals	Torque wrench and other tool
	Checking of electrical continuity and voltages	Measuring equipment
	Check level and topping up of electrolyte	Distilled water
	Ensure watertightness of the battery compartment	New seal to be changed or adjustments to battery compartment hinges
	Proper ventilation for battery compartment	Cleaning equipment or replacement
Cables	Checking security of connectors and junction boxes	New connectors Tightening tools

4.1.4. ENERGY STORAGE SYSTEM – SOLAR POWER CHARGE REGULATOR

A solar power charge regulator is necessary as the control system for charging the battery from the solar panels. For more detailed information, please refer to IALA Guideline G1186 Overview of a Floating AtoN and G1067-3 Electrical Energy Storage for AtoN.

4.1.4.1. Risks and Issues

Solar power charge regulators are affected by water ingress through cable connectors or junction boxes along with corrosion of terminals. Solar power charge regulators are also prone to theft or vandalism. Securing fasteners may also fail resulting in free movement of components which can result in damage.

4.1.4.2. Inspection Regime

How

Visual inspection and measurement of equipment using suitable measuring devices.

What

The following inspection is recommended:

Component	Inspect for	Action to be done
Solar power charge regulator	Damage, corrosion, oxidation of terminals	Replace or repair or clean
	Tightness of fasteners	Replace or tightened to correct torque value
	Electrical continuity	Measure and check
	Cleanliness	Clean
	Watertightness of housing	Check for watertightness



	Secure compartment or installation	Check for any looseness and tightened if necessary
	Proper functioning	Check for proper function, charging ampere and other parameters
Cables	Damage, corrosion, oxidation	Replace or repair or clean
	Checking security of connectors and junction boxes	New connectors Tightening tools

4.1.4.3. Maintenance

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Solar Power Charge Regulator	Cleaning	Cleaning equipment Applicable or suitable grease to terminals
	Replacement of damaged or corroded components	Replacement
	Checking of tightness of fasteners or electrical terminals	Torque wrench and other tool
	Checking of electrical continuity and voltages	Measuring equipment
	Ensure watertightness of the housing	New seal to be changed or change to a new housing
	Ensure proper ventilation for housing (if applicable)	Cleaning equipment or replacement
Cables	Damage, corrosion, oxidation	Replace or repair or clean
	Checking security of connectors and junction boxes	New connectors Tightening tools

4.1.5. LANTERN

The primary purpose of a lantern is to assist in the detection and identification of a floating AtoN at night. For further details, refer to IALA MBS, G1064 Integrated Power System Lanterns, G1065 AtoN Signal Light Beam Vertical Divergence and G1116 Selection of rhythmic characters and synchronization of lights for AtoN. Integrated power system lanterns (IPSLs) are commonly used in many cases and are increasingly used in lieu of lanterns with separate power source. However, there are still use cases for separate lanterns and power sources especially for AtoNs with longer nominal range requirement.

4.1.5.1. Risks and Issues

Damage and obscuration to the integrated solar panels on IPSL resulting in failure of the lantern. Occasionally IPSL may be improperly programmed. Like all other electrical components lanterns can suffered from water ingress, corrosion or other forms of failure resulting in a loss of operation of the lantern. Physical damage can also occur as well as the failure of securing fasteners of the lantern. Theft and vandalism may also be a risk.



4.1.5.2. Inspection Regime

How

Visual inspection including a functional test of the lantern by obscuring the photocells or observing the lantern at night.

What

The following inspection is recommended:

Component	Inspect for	Action to be done
Lantern	Damage or cleanliness of solar panel, bird spikes and lenses	Replace or clean
	Tightness of fasteners	Replace or tightened to correct torque value
	Watertightness of housing	Check for any moisture within the lenses
	Proper functioning/flash character set and optical sensor	Check for proper function, charging ampere and other parameters, generally using mobile application, or Using a darken bag to simulate nightfall to activate the optical sensors or use of remote control/Bluetooth connection
Cables	Damage, corrosion, oxidation	Replace or repair or clean
	Checking security of connectors and junction boxes	New connectors Tightening tools

4.1.5.3. Maintenance

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Lantern	Cleaning	Cleaning equipment
	Replacement of damaged or corroded components	Replacement lantern
	Checking of tightness of fasteners	Torque wrench and other tool
	Checking of electrical voltage and other parameters	Check for proper function, charging ampere and other parameters, generally using mobile application
	Ensure watertightness of the housing	Change to a new lantern if moisture found within
Cables	Damage, corrosion, oxidation	New lantern Cleaning equipment



	Checking security of connectors and junction boxes	New connectors Tightening tools
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Figure 25 Bird guano fouling of lantern



Figure 26 Testing of IPSL

4.1.6. RADAR REFLECTOR, RADAR TARGET ENHANCER

Radar Reflector (Passive Device) or Radar Target Enhancer (Active Device) may be installed on floating AtoNs to increase the radar cross section or radar return for better visibility on radar. For more information, please see IALA Guideline G1174 Radar reflectors for marine aids to navigation.

4.1.6.1. Risks and Issues

The key issues regarding radar reflectors or radar target enhancers are physical damage to the radar or degradation of the reflecting surface causing a reduction in effectiveness. Vandalism or theft may also be an issue. Failure of fasteners or securing devices can occur. Caution is required when painting radar target enhancers as the use of incorrect paint may reduce the effectiveness. Water ingress can also occur in the electrical connections of radar target enhancers.

Radar reflectors or radar target enhancers may be contained within the structure of a buoy which could make inspection difficult.

4.1.6.2. Inspection Regime

How

Visual inspection including a functional test of the effective of the radar reflector or radar target enhancer from a suitable vessel or shore-based equipment.

What

The following inspection is recommended:

Component	Inspect for	Action to be done
Radar Reflector	Cleanliness	Clean
	Damage, corrosion, oxidation	Replace or paint
	Tightness of fasteners	Replace or tightened to correct torque value



Radar Target Enhancer (RTE)	Damage, corrosion, oxidation	Replace or repair or clean
	Any paint on the RTE	Replace
	Checking security of connectors and junction boxes	New connectors Tightening tools

4.1.6.3. Maintenance

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Radar Reflector	Cleaning	Cleaning equipment
	Painting	Tools for preparation Painting system
	Replacement of damaged or corroded components	Replacement radar reflector
	Checking of tightness of fasteners	Torque wrench and other tool
Radar Target Enhancer (RTE)	Damage, corrosion, oxidation	Replace or repair or clean Replacement RTE
	Checking security of connectors and junction boxes	New connectors Tightening tools Replacement RTE

4.1.7. Supplementary and Complementary Equipment

This consist of any supplementary and complementary equipment installed on floating AtoN such as Automatic Identification System (AIS) AtoN/Remote Control Monitoring System (RCMS)/Meteorological sensors that might be installed on the floating AtoN. These include the connection from the equipment to the structure of the buoy and electrical connections between the different components via cabling and junction boxes.

4.1.7.1. Inspection Regime

How

Visual inspection and measurement of equipment using suitable measuring devices. The operation of equipment can be verified from a suitable vessel or shore-based application depending on the type of equipment.

What

The following inspection is recommended:

Component	Inspect for	Action to be done
Aerials/Antenna	Tightness of fasteners	Replace or tightened to correct torque value
	Damage, corrosion, oxidation of connectors	Replace or repair or clean
	Checking security of connectors and junction boxes	New connectors Tightening tools



	Any paint on the antenna	Remove paint or replace
Automatic Identification System	Proper functioning	Check for proper function of equipment, typically can be seen on the ECDIS onboard the buoy tender or via mobile applications
Remote Control Monitoring System	Proper functioning	Check for proper function of equipment, typically can be seen on the monitoring system
Meteorological sensors	Proper functioning	Checking of proper functioning of the sensor such as anemometer, acoustic doppler current profiler, water quality monitoring sensors etc

4.1.7.2. Maintenance

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Aerials/Antenna	Cleaning	Cleaning equipment
	Replacement of damaged or corroded components	Replacement Aerials/Antenna
	Checking of tightness of fasteners	Torque wrench and other tool
	Checking integrity/security of connectors and junction boxes	New connectors Tightening tools Grease or waterproofing tape
Automatic Identification System	Checking of tightness of fasteners	Torque wrench and other tool
	Replacement of damaged or corroded components	Replacement AIS equipment
	Checking integrity/security of connectors and junction boxes	New connectors Tightening tools Grease or waterproofing tape
Remote Control Monitoring System	Checking of tightness of fasteners	Torque wrench and other tool
	Checking integrity/security of connectors and junction boxes	New connectors Tightening tools
Meteorological sensors	Checking of tightness of fasteners	Torque wrench and other tool
	Checking integrity/security of connectors and junction boxes	New connectors Tightening tools
	Replacement of damaged, corroded or malfunctioning components	Replacement meteorological sensors



		Refer to manufacturers maintenance guidelines for these sensors
--	--	---



Figure 27 AIS



Figure 28 Met-hydro sensor should be checked

4.1.8. RACON

Radar Beacon (RACON) can be fitted on certain floating AtoN depending on the risk assessment considering the type of traffic and the traffic density. The required maintenance includes checking the connection between them via cabling, fastenings and enclosures.

4.1.8.1. Risk and Issues

Racones may be physically damaged including the loss of secure fastening and may be prone to theft or vandalism. Electrical connections may become loose or corroded and water ingress can occur inside the body of the Racon. The Racon may emit electromagnetic radiation which should be a consideration when undertaking maintenance.

4.1.8.2. Inspection Regime

How

Visual inspection and measurement of equipment using suitable measuring devices. The operation of equipment can be verified from a suitable vessel.

What

The following inspection is recommended:

Component	Inspect for	Action to be done
RACON	Tightness of fasteners	Replace or tightened to correct torque value
	Damage, corrosion, oxidation of connectors	Replace or repair or clean
	Checking security of connectors and junction boxes	New connectors Tightening tools
	Any paint on the RACON	Remove paint or replace



	Proper functioning	Check for proper function of equipment, typically can be seen on the radar onboard the buoy tender Laptop with hyper terminal or hyper programme
--	--------------------	---

4.1.8.3. Maintenance

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
RACON	Cleaning	Cleaning equipment
	Replacement of damaged, malfunctioning or corroded components	Replacement Racon
	Checking of tightness of fasteners	Torque wrench and other tool
	Checking security of connectors and junction boxes	New connectors Tightening tools



Figure 29 RACON should be inspected

4.1.9. AUDIBLE SIGNALS

Audible signal system can be fitted on certain floating AtoN depending on the risk assessment considering the type of traffic and the traffic density. The required maintenance includes checking the connections between the audible signal device via pipes, cabling, fastenings and/or enclosures. The function of the audible signal must also be confirmed.

4.1.9.1. Inspection Regime

How

Visual inspection of components as well as observation from suitable location or shore.

What

The following inspection is recommended:



Component	Inspect for	Action to be done
Audible signal device	Tightness of fasteners	Replace or tightened to correct torque value
	Damage, corrosion, oxidation of connectors/pipes/mechanism	Replace or repair or clean
	Checking security of connectors and junction boxes	New connectors Tightening tools
	Proper functioning	Check for proper function of audible signal device

4.1.9.2. Maintenance

The following maintenance are recommended to be performed:

Component	Maintenance to be done	Equipment required
Audible signal device	Cleaning	Cleaning equipment
	Replacement of damaged or corroded components	Replacement
	Checking of tightness of fasteners	Torque wrench and other tool
	Checking security of connectors and junction boxes	New connectors Tightening tools

5. RECORDING OF MAINTENANCE

Detailed maintenance records should validate the performance and effectiveness of the maintenance plan. Maintenance records should include:-

- Findings of all inspections undertaken including any non-conformances and all measurements taken, in particular, the measurements on all moorings and their components.
- Works undertaken during any maintenance including parts used, and
- Works not undertaken and the reason why this was not possible to complete the maintenance works

Maintenance records should be used to facilitate a feedback loop to designers and manufacturers and it is recommended that maintenance records and information are analysed to assess the causes of any component failure discovered, in order to improve the performance and reliability of the floating AtoN.

Competent Authorities should develop their own standard method of recording for maintenance activities and works, a sample of which is attached in the Appendix for reference.

Commented [148]: We should include a sample maintenance record for Floating AtoN Maintenance



ANNEXE A EXAMPLE OF A MAINTENANCE RECORD FOR FLOATING ATON

TO BE COMPLETED BY SHORE BASE				
LOCATION (Name):	Outfall Buoy No 1		AREA:	Anytown
COMPETENT AUTHORITY OR CONTRACT:	Contract		CONTRACT	Water Company
TYPE OF BUOY:	Special Mark		CLASS:	4
TYPE OF SERVICE:	Renewal	Casualty Service	SERVICE/REPLACE SCHEDULE	Annual/Water Company dependant
TOP MARK FITTED:	Yes		NEXT REPLACE DATE:	N/A
BUOY SUPERSTRUCTURE NO	N/A		BUOY BODY NO	N/A
RADAR REFLECTOR:	No		LUGS TESTED:	N/A
LIGHT BATTERY TYPE & QTY:	Self-Contained Lantern		RACON BATT TYPE & QTY:	N/A
BATTERY ID NO'S:	Self-Contained Lantern			
SOLAR PANEL NO'S:	Self-Contained Lantern			
SOLAR PANEL WATT:	4 x 5W		LANTERN NO:	Unknown
LANTERN TYPE:	BRIGHTLIGHT Self contained		BLUETOOTH:	NO
CHARACTER:	Fl.Y.5s		RACON FITTED:	NO
AIS FITTED:	NO		RACON SERIAL NO:	N/A
MONITORING FITTED	NO		RACON CHARACTER:	N/A
MMSI NUMBER:	N/A			
TO BE COMPLETED BY BUOY TENDER				
VESSEL:	Buoy Tender Star		DATE OF VISIT:	05-05-2020
MASTER:	Capt. Smith		2/O:	D. Jones
POSITION VERIFIED	Yes		CHART NUMBER:	3126, 3220
LATITUDE WGS84:	25° 36.936'N		LONGITUDE WGS84:	025° 45.283'W
CLEANED LANTERN	Yes		CLEANED BUOY:	Yes
WEIGHTED SKIRTS FITTED:	No		BRIDLE:	2M Y
CHAIN SIZE & LENGTH	25mm x 50M		DEPTH IN METRES:	17.4M
SINKER:	1T		DATE SINKER EXAMINED:	05/05/20
WORKING PART :	19mm		AIS/RACON OPERATIONAL:	N/A
SOLAR PANEL NO'S:	Self-Contained Lantern			
SOLAR PANEL VOLTAGE:	Self-Contained Lantern			



		LIGHT BATTERY VOLTAGE:	Self-Contained.
DATE LAST REPLACED:	N/A	NEXT SERVICE DATE:	05/2021
DATE LAST SERVICED:	05/05/20		
TO BE COMPLETED IN EVENT OF CASUALTY			
DATE/TIME REPORT RCV'D:		CASUALTY TYPE:	
SOURCE OF CASUALTY:			
DATE/TIME RECTIFIED / REPORTED TO			
PROCUREMENT SYSTEM STOCK NO ISSUED:	N/A		
GENERAL COMMENTS: (e.g. Amount of chain clenched into the mooring, No. of shackles & pins used etc.)			
0820 Buoy Tender Star arrived on station. 0826 Buoy decked for annual service. Service completed. Buoy cleaned & electrics tested & found in good order. 0850 Buoy re-laid in Charted Position			
1 x Forelock used from ships stores (No Stock Number)			
FAULTS/DEFECTS FOUND DURING SERVICING; (e.g. defective solar panel).			
N/A			

CONTRACT BUOYWORK CHECKLIST

Only to be completed when Contract buoyage is carried out

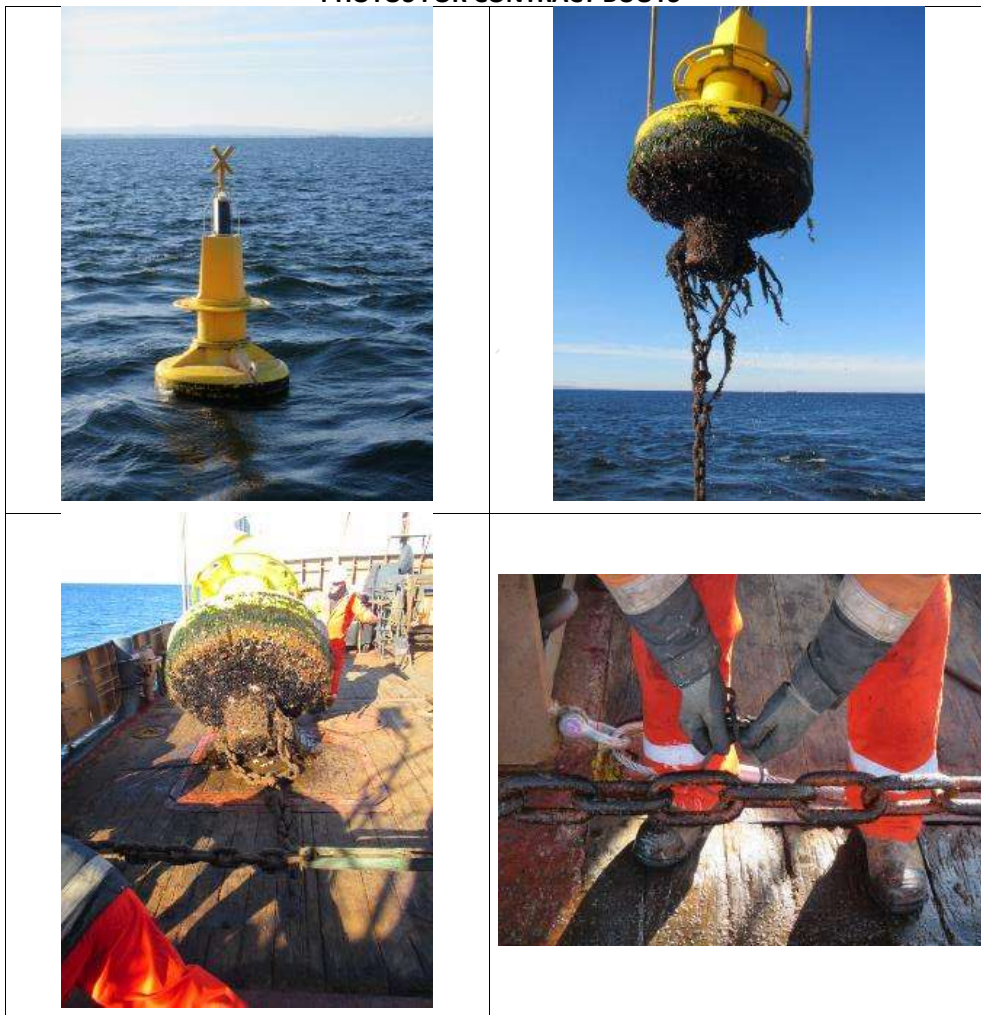
The following checklist is to be completed during the servicing of all contract buoys and signed off by the Second Officer on completion of service.

<u>Lantern and Solar Panels</u>	
1. Does the lantern show any signs of damage	No
2. Are the cable glands and seals in good order	N/A
3. Is the flasher character as charted	Yes
4. Is the flasher unit in good order with no sign of dampness	Yes
5. Are all the connectors and cabling in good order	Connections are internal
6. Was a new bulb fitted (if applicable)	N/A
7. Do the solar panels show any sign of damage	No
<u>Float and Superstructure</u>	
8. Is the float in good condition	Yes



9. Are the lifting eyes and mooring eyes in good condition	Yes
10. Is the superstructure securely attached to the buoy body (if applicable)	Yes
11. Are the daymark panels securely attached and free from damage	Yes
12. Several photos should be taken of all commercial buoys whether client or Competent Authority owned as part of information sent to Contract Manager	OK
I certify that the above checklist has been completed and full details of the work carried out along with photographs and any remedial actions undertaken and future recommendations are contained in the enclosed report.	
Second Officer: D. Jones	

PHOTOS FOR CONTRACT BUOYS







IALA Guideline Gnnnn Maintenance of Floating Aton
Edition x.x urn:mnr:iala:pub:gnnnn P 38

ANNEXE C-LANTERN CONFORMITY TEST RECORD



Lantern Test

Lantern Identification

Vendor/Supplier: SPX AIDS TO NAVIGATION

Product Name: SABIK LED160 BUOY LANTERN-Bluetooth

Lantern Color: RED 

Model: LED160-R10D

Serial Number: 252301604045

Ref PO: 000039612

Stock code: S2060092

Date Arrived at buoy yard: 18 JUNE 2025

Date of Test: 20 JUNE 2025

Tested by: Joe Bloggs

Lantern Passed

Test Checklist

Physical inspection of lantern, cable gland, cable and connector:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Bird Spike:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Does photocell control work?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Does it communicate through the App?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Can it be programmed via the App?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
GPS: If "yes" GPS Sync ?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
Does it flash?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A

Observations:

If find any visual physical damage/broken, supply pictures down below:

Programmed :

Flash light code 131, 75-175lux



ANNEXE D-SAMPLE MOORING MAINTENANCE RECORD DOCUMENTS

AtoN Name	Mooring Line Description					Link Measurements (mm)						
Float Aid	Component	Ø (mm)	Coefficient	Length (m)	Installation Date	Date	Top	Middle	Bottom	Clutch (Between links)	Wear (%)	Comments
Bormes N°1	Bridle	20	3D	2	14/05/08	16/04/09	15 mm	15 mm	15 mm	31 mm	25%	cleaned from fouling
	Riding chain	20	3D	0								
	Trash chain	25	3D	10	14/05/08	16/04/09	15 mm	15 mm	15 mm	28 mm	25%	To Change next visit
	ground chain	25	3D	10	14/05/08	16/04/09	22 mm	21 mm	22 mm	33 mm	16%	

Buoy reference

Date / / Date / / Date / /

Point

Anode

Tail chain

Riding chain

Thrash chain

Ground chain

Shackle 1

Shackle 2

Shackle 3

Shackle 4

Shackle 5

Shackle 6

Swivel

Mooring eye

Position

Buoy

Sinker

Measurement

Kg

A mm B mm

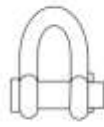
Kg

A mm B mm

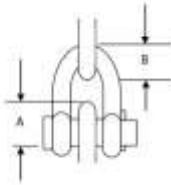
Kg

A mm B mm





Check that nail and or nut securing the shackle are in place and tight.

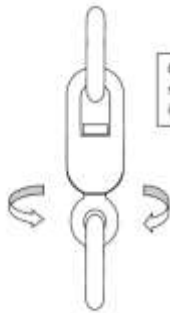


Measurement A

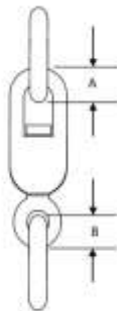
Measure the thickness between the pin and the link of chain

Measurement B

Measure the thickness between the Shackle and the link of chain



Check that the swivel still turns in both directions

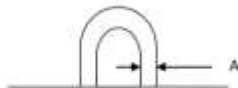


Measurement A

Measure the thickness between the upper link and the swivel.

Measurement B

Measure the thickness between the lower link and the swivel.

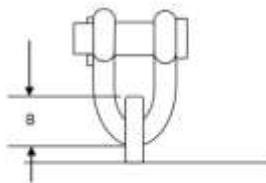


Measurement A

Measure the thickness of mooring eye of the sinker

Measurement B

Measure the thickness between the mooring eye of the sinker and the shackle.





ANNEXE E-BUOY MAINTENANCE RISK ASSESSMENT

Buoy Maintenance										
Work on Vessel										
Step	Action	What can go wrong?	What would happen if it did?	Risk evaluation			What can be done to prevent this	Risk evaluation		
				C	L	HR		C	L	HR
1	Bolting	Spanner slips	Cuts and bruise	2	4	8	Wear Gloves and PPE	1	4	4
2	Element assembly	Pinch hazard	loss of fingers Cuts and bruise	4	3	12	Wear Gloves and PPE	2	2	4
3	Site access	Trip hazards wet deck	Cuts and bruise	3	4	12	Keep a clean site, Keep clear walkways, Wear security boots and PPE's	2	2	4
4	Uncontrolled access	Persons exposing themselves and others to risk of injury	Cuts and bruise	2	4	8	secure work area	2	2	4
5	Communication	Unclear instructions poor communication	Damage to equipment, injury to personnel	3	4	12	Pre-work Tooltalk, Ensure that communication procedure is understood	2	2	4
6	working near the side of the vessel	Man overboard	Drowning	5	3	15	Pre-work Tooltalk, man overboard processor, accessible life rings, life jackets to be worn and PPE's	2	3	6
7	Weather	movement of equipment on the deck	Damage to equipment, injury to personnel man overboard	3	4	12	Pre-work Tooltalk, agree on maximum wave height, maximum wind when work will be stop	3	2	6
Working from workboat										
8	Approaching the buoy	Contact with the buoy	Damage to the buoy/workboat	2	5	10	Approach the buoy with care work with the swell wind and current	1	3	6
9	Boat to buoy transfer	Man overboard Pinch hazard	Drowning loss of fingers Cuts and bruise	5	3	15	Pre-work Tooltalk, man overboard processor, accessible life rings, life jackets to be worn and PPE's	2	3	6
10	working on the buoy	Man overboard, Risk of injury with excessive movement of the buoy, Trip hazards wet deck	Drowning, Cuts and bruise	5	3	15	man overboard processor, accessible life rings, life jackets to be worn and PPE's	2	3	6
11	Weather	Man overboard, Risk of injury with excessive movement of the buoy,	Drowning, Cuts and bruise	5	3	15	Pre-work Tooltalk, agree on maximum wave height, maximum wind when work will be stop	3	2	6
Lifting										
12	Lifting by hand	Lifting badly Dropped equipment	Pull muscles back injuries	3	3	9	Do not lift more than n 35KG on your own Use correct lifting techniques Wear security boots and PPE's	2	2	4
13	Lifting by lifting equipment	Dropped equipment	Damage to equipment, injury to personnel	4	3	12	Control of lifting equipment, Control of rigging, Control of operator Wear helmets and PPE's	2	3	6
14	Communication	Unclear instructions poor communication	Damage to equipment, injury to personnel	3	4	12	Pre-work Tooltalk, ensure that communication procedure is understood	2	2	4
15	Weather	Movement of equipment on the deck	Damage to equipment, injury to personnel man overboard	3	4	12	Pre-work Tooltalk, agree on maximum wave height, maximum wind when work will be stop	3	2	6
16	Swinging lode	The equipment can swing out of control	Damage to equipment, injury to personnel man overboard	5	3	15	Use of tag lines, do not pass maximum weather conditions	3	2	6
Mooring										
17	Line	Bad assembly of mooring line	Mooring line can break, loss of equipment,	5	3	15	control of the full mooring line and all connections before installation,	2	2	4
18	Handling Line	Pinch hazard	loss of fingers Cuts and bruise	4	3	12	Use proper handling equipment, Wear Gloves and PPE	2	2	4
19	Mooring	movement of equipment on the deck	Damage to equipment, injury to personnel man overboard	5	3	15	Pre-work Tooltalk, always work behind equipment going overboard.	2	3	6
L= Likelihood C= Consequence HR= Hazard Rating PPE = Personal Protection Equipment										